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THE  
**COTTON MANUFACTURE**  
OF THE  
**UNITED STATES OF AMERICA**  
CONTRASTED AND COMPARED  
WITH THAT OF  
**GREAT BRITAIN.**







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A  
PRACTICAL DETAIL  
OF THE  
COTTON MANUFACTURE  
OF THE  
UNITED STATES OF AMERICA;  
AND THE STATE OF THE  
COTTON MANUFACTURE OF THAT COUNTRY  
CONTRASTED AND COMPARED  
WITH THAT OF  
G R E A T B R I T A I N ;  
WITH  
COMPARATIVE ESTIMATES  
OF THE COST OF MANUFACTURING IN BOTH COUNTRIES.  
ILLUSTRATED BY  
**APPROPRIATE ENGRAVINGS.**

ALSO,

A brief Historical Sketch of the Rise and Progress of the Cotton Manufacture in America, and Statistical Notices of various Manufacturing Districts in the United States.

BY JAMES MONTGOMERY,  
SUPERINTENDENT, YORK FACTORIES, SACO, STATE OF MAINE;  
AUTHOR OF "THE THEORY AND PRACTICE OF COTTON SPINNING," AND  
"THE COTTON SPINNER'S MANUAL."

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## P R E F A C E.

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THE writer of the following Details, upon leaving Scotland in the beginning of 1836, was strongly urged by his friends to communicate some account of the practical state of the Cotton Manufacture of the United States, so far as it might fall under his observation. In complying with that request, he found that mere general statements would not suffice, and was therefore obliged, in order to fulfil his promise, to enter somewhat into details. In doing so, his materials accumulated to an extent greatly above what he originally anticipated ;—they at least became too bulky for mere epistolary correspondence. And, being aware of the interest felt by the British regarding every thing connected with America, and, at the same time, knowing the vague opinions which prevail regarding the practical state of the Cotton Manufacture in this country, he was led to believe that there might be something in these details not altogether uninteresting to many employed in the Cotton Manufacture in Great Britain. Under these impressions he has been induced to lay them before the public, especially as the most contradictory reports have been circulated in that country, by many who have visited America.

It may be proper to state, that the chief object kept in view by the author in the following pages, has been to give simple facts, without depreciation or exaggeration on either side ; he has been careful to state nothing upon any information, but such as he thought might be implicitly relied on, and is unconscious of having made a single statement that will not, upon examination, be found to be correct.

At present the attention of the author has been chiefly confined to that which was thought might be most interesting to his friends ; each machine has been noticed in its order ; whatever was in any respect different in them from those with which he was acquainted in Great Britain, has been described. The practice of this country is contrasted with that of Great Britain, and the advantages or disadvantages of both pointed out. Drawings are given of some of the most important machines which are constructed here in a different form from those employed for the same purposes in Great Britain.

To render the work as interesting as possible to proprietors, as well as to those employed in the practical department of the business, estimates have been given of the cost of buildings, machinery, and other materials used in the manufacture ; notice has also been taken of the general speeds at which the different machines are driven, the amount of work produced, the number of hands employed, the hours of labour, and the ordinary rates of wages ; so that

fair estimates may be formed of the actual difference of the cost of manufacturing in the two countries. These, it is believed, will be interesting to those employed in the manufacture ; while, it is hoped, that the Historical Sketch of the introduction of the Cotton Manufacture into the United States, and the Statistical Notices of various Manufacturing Districts, will be equally interesting to the general reader.

To ensure correctness, the various statements have been submitted to the inspection of several gentlemen in both countries, in whose judgement, experience, and practical knowledge of the Cotton Manufacture in all its details, the author has the utmost confidence.

Such is the origin and design of the present work ; and the object of the author will be fully attained, if it shall in any manner contribute to disabuse the public mind, and assist manufacturers in Great Britain to understand correctly, the present position of both countries with regard to the Cotton Manufacture. It must be confessed that the most formidable rivals with whom the British have to compete in this important manufacture, are the Americans ; their immense water power, together with their being the growers of the raw material, giving them advantages which no other nation enjoys. So long as the British can manufacture cheaper than the Americans, just so long will they

retain a monopoly of the trade. But every step the latter advance in reducing their expenditure, the nearer do they approach to an equality with the former. The Factories in Great Britain are already conducted in general with the most rigid economy, so that their only chance now, is improvements in their machinery, by means of which the processes may be expedited, and the cost of manufacturing thereby reduced. But the Americans may also make improvements on their machinery, so as to derive similar results; and certainly they have more resources to which they can apply themselves, as by committing the charge of their Factories to competent persons, immense savings might yet be effected, of which they seem in general not to be aware. These savings too, might be effected without waiting for new inventions or improvements in machinery, or resorting to a reduction of wages. These, together with the reasons already stated, operated as inducements to lay the following details before the public, most of which have been written at different times, and in the midst of other engagements, which is the only apology the author has to offer for their many imperfections.

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THE  
COTTON MANUFACTURE  
OF THE  
UNITED STATES  
CONTRASTED AND COMPARED  
WITH THAT OF  
GREAT BRITAIN.

PLAN AND ARRANGEMENT OF THE MILLS.

THE Cotton Factories in America are scattered over a vast extent of territory. But there are three particular divisions which may be denominated the principal manufacturing districts; the first of which is the Eastern, comprehending Maine, New Hampshire, Vermont, and the Eastern parts of Massachusetts. The second, or middle district, includes the Western parts of Massachusetts, Rhode Island, and Connecticut. The third, New York, New Jersey, Pennsylvania, &c. &c. In the above districts the principal manufacturing towns and villages are,—in the first, Lowell, which is decidedly the largest and most important in the United States; also, Waltham, Taunton, Fall River, Springfield, and Three Rivers, all in Massachusetts; Dover, Great Falls, New-Market, and Nashua in New

Hampshire; and Saco in Maine. There are besides, a number of insulated Factories that do not require particular notice. All the manufacturing establishments in this district belong to joint stock companies, and, in general, they follow the Lowell plans in the form and arrangement of the Mills, as well as in the style of their machinery.

The principal manufacturing towns and villages, in the second or middle district, are—Providence and the vicinity, which, within a circuit of 30 miles, may comprehend from 70 to 80 Mills, including Pawtucket, Smithfield, Lonsdale, Coventry, Cumberland, Cranston, Warwick, Scituate, Johnston, &c. together with Newport. In Connecticut there are Greenville, Cabotsville, Williamantic, Norwich, Jewitts City, &c. Though many of the Cotton Factories in this district belong to corporations, yet the greater number are the property of private companies or individuals. And, as it was here the cotton manufacture first commenced, a vast portion of the machinery is old, and exhibits all the different stages of improvement. But the best and newest Mills being in or near Providence, the others generally copy their plans and style of machinery.

The principal manufacturing towns and villages, in the third or Southern district, are the towns of Paterson in New Jersey, (which is next to Lowell as regards the number of its manufactories); Matteawan, New York; Manayunk near Philadelphia; Baltimore, &c. &c. The Factories in this district generally adopt the plans and improvements of Paterson and Matteawan, and these latter obtain machines or models of all the newest improvements

from Manchester and Glasgow, which they put in operation in this country. Their style of machinery is therefore a little different from that of the other two districts. The Rhode Island machinery also varies considerably from that of the Lowell or Eastern district.

The principal Machine Manufactories are at Lowell, Massachusetts; Providence and Pawtucket, Rhode Island; Paterson, New Jersey; Matteawan, New York.

The plan of the Mills is nearly the same in the different districts. None that I am aware of exceed five stories in height, except two at Dover, which are six stories on one side and five on the other. The general height of the Mills in this country is three or four stories with an attic.—*See Plate I. Fig. 2d.*—But the Mills recently built at Lowell are five stories high, with a plain roof, such as Fig. 1st; from which it seems probable, that though the double roof has been the plan generally adopted, it is likely to be abandoned, as it is certainly the most expensive, nor does it give so much room for machinery as the five stories and a plain roof.

The general height of Cotton Mills in Scotland is six stories with a plain roof. Those in England are from six to eight stories high; Stirling and Becktow's Mill, lower Moseley Street, Manchester, is nine stories.

There are a few Mills in this country driven by high pressure steam engines. There are four in Newport, and one in Providence, Rhode Island; and three in Newburyport, Massachusetts. The coals used, whether anthracite or bituminous, cost

from seven to eight dollars per ton. In general the Mills throughout the United States are moved by water; indeed, the water power resources of this country are incalculable, and many years must elapse before they can be fully brought into use. In arranging the Mills, the water wheels are necessarily put under cover, so as to be kept in an atmosphere considerably above the freezing point in winter, otherwise the severity of the frost, which frequently descends to nearly 30 degrees below zero, would prevent them from operating a great part of the year; hence the water wheels are generally placed in the basement story, which, besides the wheels, contains the mechanics' shop and cloth room; or sometimes it is filled, in whole or in part, with machinery. The second flat contains the carding engines, &c.; the third, the spinning; and the fourth and attic, the weaving and dressing machinery, &c. This is the most general arrangement of the Mills in this country, particularly in the Eastern district, where, it is proper to notice, the spinning is nearly all done by throstle spinning frames. In the middle and Southern districts, there are a considerable number of mules, employed generally for spinning weft, and here the arrangements are sometimes a little different, the mules being frequently placed in the upper flats.

The Cotton Factories of Great Britain generally have their picking or scutching rooms within the Mill; but in this country there are separate buildings erected for these purposes, generally standing like guard-houses about 20 or 30 feet from the main building, with the passages that connect them se-

cured with iron doors, to prevent the communication of fire to the loose cotton in the picking-house.

It is said that Cotton Mills in this country are very liable to take fire, for which I cannot assign any particular cause, at least for such as are heated by steam; those heated with hot air may be more liable to such accidents, especially when wood is used for fuel. Some of the Mills lately built at Lowell, have iron shutters outside the windows, to prevent the communication of fire from one Mill to another; and each Mill has expensive apparatus fitted up for extinguishing fires, such as forcing pumps for raising water to a cistern at the top of the Mill, from which pipes descend into every apartment; and these not only serve to deluge the Mill in case of fire, but also to supply each room with water for washing, as every apartment has its water trough, or what is denominated a sink, for the workers to wash their hands and face in; a most healthy, as well as cleanly operation, which is punctually attended to before every meal, soap being supplied for this purpose by the proprietors. Besides these forcing pumps and water pipes inside, a considerable number of the large Mills have platforms outside, with ladders extending right over the top of the building; and in general, each Factory, (particularly in the Eastern district,) is furnished with what is called a watch clock, for the purpose of keeping the night watchman always on the alert. These clocks resemble a common time-piece with a circular dial made to revolve: and surrounding the dial about half an inch from the circumference, there are a number of small pins,

which the watchman is required to shift: but the clock is so constructed, that one pin only can be shifted at certain intervals of time; as, for example, at the end of every half hour: the clock also contains a certain number of springs, each one of which must be lifted before one pin can be shifted; but as the clock is all enclosed except the dial, there are wires connected with these springs, and with each room in the Mill; these wires are also all enclosed, except at their extremities in the different apartments, therefore, in order to shift one pin, the watchman requires to go into every room in the Mill, for the purpose of pulling each wire separately, and this he must do at the end of every half hour; for if the pins are not shifted at the proper time, they cannot be shifted at all: and the superintendent of the works carefully examines these clocks every day to ascertain whether all the pins have been shifted; by which means he can at once know when the watchman neglects his duty. Some clocks are so constructed, that one wire only can be drawn at the end of every five or six minutes; so that when the watchman draws the wire in one room, he must wait some time before he can draw the next; by which means he is kept moving about all the time.

It is somewhat remarkable, that, in general, no such provision is made in the Cotton Factories of Great Britain for the prevention of fire. Except in a few instances, there are in that country neither forcing pumps and water pipes inside, nor platforms or ladders outside the Mills. Indeed there are a number of Mills in country places in Scotland that have no night watchman either in winter or summer.

The method of conveying motion from the first moving power to the different departments in the Factories of Great Britain, is by means of shafts and geared wheels; but in this country it is done by large belts moving at a rapid speed, the breadth of which is 9, 12, or 15 inches, according to the weight they have to drive, and passing through a space of from 2500 to 3600 feet per minute. A belt 15 inches broad, moving at the rate of 3000 feet per minute, is considered capable of exerting a propelling force equal to 50 horses' power. All the most recently built Mills are belted, whilst many of the older ones have had the shafts and gears removed, and belts substituted in their place; indeed, belts are generally preferred even by those who have had sufficient experience of both. There are various opinions regarding the best plan of fitting up the drums and shafts so as to apply belting to most advantage. Plate I. represents two different plans; a greater number might have been given, but these, it is presumed, will be sufficient for our present purpose.

Plate I. Fig. 2d. represents a plan of driving the whole machinery by one large belt. B is the basement story or wheel room; C is the carding; S the spinning; and W W the weaving rooms. A is the water wheel; D the main drum driven by and geared from the water wheel, and is generally from eight to twelve feet in diameter; e e e e represent the lines of drums and shafts in the carding room, which also drive the spinning frames by means of belts passing up through the floor; i i i i i represent the lines of drums in the first weaving room,

from which motion is conveyed to the second by belts passing up through the floor. The dotted line represents the main driving belt, which gives motion to all the drums; *a a a a* are the belt binders, which guide or lead it in the directions required, and are suspended on springs or swivels, so as to bind or take up the slack of the belt, and keep it always at a proper degree of tension. The large belt, as here represented, would be between three and four hundred feet long, from twelve to fifteen inches broad, and would require from 600 to 700 lbs. of good belt leather to make it. Such belts are always made from the centre of the back of the hide, so that they may stretch equally at both sides.

Belts put in operation upon this plan are bulky, ponderous, and unmanageable; and when they break, (an accident to which they are very liable on account of the great weight they have to drive,) run off the drums, and cause a hinderance to the whole work; besides, it takes five or six men nearly half a day to prepare them for being again put in operation. They also cause a great strain upon the journals of the shafts, thereby increasing the power required to operate the Mill in consequence of the multiplied friction; the journals also heat and wear beyond the power of any lubrication to prevent, hence this plan of belting is not very generally adopted.

Plate I. Fig. 3d. represents another plan of gearing with belts, which is generally adopted about Lowell, and considered the most unobjectionable of any that has yet been tried; B is the basement story; C the carding; S the spinning; and W W the weaving rooms; E E the water wheels; F the

main driving drum ; D the main drum in carding room ; H the main drum in first weaving room ; A A A A the lines of main shafts in carding and weaving rooms ; I I the two main driving belts ; G the second driving belt. There are binders at I I, which exert a pressure of about 30 or 40 lbs. against each belt, so as to keep them always at a proper degree of tension.

Two such belts from 12 to 15 inches broad, are capable of operating 5000 throstle spindles with the necessary preparation and weaving for coarse heavy goods, which require a propelling force equal to between 80 and 90 horses' power. The spinning frames being constructed on the plan of what is called the dead spindle, (same as what in Scotland are denominated the Glasgow Patent Throstles,) require considerably greater power than what is sufficient for driving the common throstle. Some of the most recently built Mills at Lowell have only one broad belt from F to D, instead of two ; which seems to perform its operations equally well.

The two plans of gearing with belts, represented in Plate I., will be considered interesting, the one from its novelty, the other from its being considered the best now in operation. However partial manufacturers in this country may be to this mode of conveying motion to the different apartments, those who have been accustomed to the neat manner in which Factories are geared in Great Britain, must regard the above as heavy, clumsy, and inconvenient, as well as more expensive. As all these large belts have to be enclosed, they occupy a considerable portion of the rooms they pass through; which,

besides interrupting the view, gives less space for arranging the machinery; they are likewise very liable to stretch, and when too slack, they will slip on the drums: and owing to their breadth, it requires a considerable time to cut out one joining and sew them up again; but in order to prevent them from slipping, they are generally well soaked with currier or neat's foot oil, or the following composition which is much recommended, viz. two pounds of common tallow, one of bayberry tallow, and one pound of bees' wax: these are melted until they are completely incorporated; and, while boiling, applied to both sides of the belt with a brush; and in order to make the composition strike into the heart of the leather, the belt is then drawn slowly over a hot furnace, by which means the wax is completely decomposed, and with the tallow, penetrates every pore of the leather, until the whole belt is fully saturated. After being prepared in this manner, nothing more is required, than to lay on a thin layer of the same composition, at the end of every five or six months. The drums are also covered with leather, prepared in the same manner, and fastened on with wooden pegs, such as shoemakers use for fixing the soles on boots or shoes.

Though the Mills in this country are not so high as those in Great Britain, they are generally very strong and durable. Instead of joists for supporting the floors, there are large beams about 14 inches by 12, extending across from side to side, having each end fastened to the side wall by a bolt and wall plate: these beams are about five feet apart, and supported in the centre by wooden pillars, with a double floor

above. The under floor consists of planks three inches thick ; the upper floor of one inch board. Some have the planks dressed on the under side, others have them lathed and plastered : the floor being in all four inches thick, is very strong and stiff. The average thickness of the side walls may be from twenty to twenty-four inches, and they are generally built of bricks. There are very few stone walls, free stone being scarce in this country.

The preceding remarks embrace the principal things which a stranger, on visiting the Cotton Factories of the United States, is most likely to notice as differing in them from the general plan of those in Great Britain. It will be observed, that the only particulars in which those of the former differ from those of the latter country are,—*first*, the Factories are not so high in this country ; *second*, the double roof is peculiar to the American Factories ; *third*, belts are employed for conveying motion to the various apartments; *fourth*, the floors are laid on large beams instead of joists ; and *fifth*, in the arrangement of the machinery.

In Great Britain, the weaving is generally in the lower stories, and the carding and spinning above ; but in the States, the weaving is contained in the upper stories, with the carding and spinning below. Instead of large beams laid across the house for supporting the floors, the Factories in Great Britain have joists about three inches by ten ; these are laid on their edges about twenty inches apart, with one inch flooring above, lathed and plastered beneath, or sheathed with thin boards. The joists are also supported in the centre by a beam about eleven

inches by six, running from end to end of the building ; the pillars are of cast iron, and placed right under this beam : the beam does not rest on the pillar, but on a cast iron case, which passes up on each side of the beam, and meets together above ; so that, whilst the under part of this case rests on the top of the pillar, the upper part supports the pillar above ; thus leaving the beam entirely free of the pillars in the rooms above ; by which means the uppermost floors are supported on columns of cast iron from the foundation ; there is therefore no danger of such floors sinking in the centre. But in this country where the cross beams rest on the top of the pillars, whilst the pillars above rest again upon the beams, the floors in the upper stories sink down in the centre, in consequence of the shrinking of the timbers, and the pressure of the ends of the pillars into the beams. The writer has seen some of these which have sunk down four and five inches in the course of four years.

The Factories in Great Britain are generally moved by steam engines placed outside of the main building, and motion is conveyed to the different apartments by shafts and geared wheels. Some of the factories in this country have the water wheels outside of the main building, but generally all the new Mills use belts for gearing ; but whether belts require more or less power than the other mode of gearing, the writer has not been able to ascertain satisfactorily. There are various opinions upon the subject. There are two Mills at Fall River, in the State of Rhode Island, which seem to decide the question in favour of the belts. These Factories

have equal water power, as the one takes exactly what passes through the other. The one is geared with belts, the other with shafts, &c.; and it is found that the former can put in motion a considerably greater quantity of machinery than the latter; still I incline to the belief that if shafts and geared wheels are fitted up on the newest and most improved principles, they will be both cheaper and run lighter than belts. Some object to the grating noise of wheels, but this in Great Britain is no objection at all, as the wheels are mostly outside the building; besides, geared wheels, when properly made and fitted up, will run as silently and smoothly as belts.

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#### THE WILLOW.

THE Willows used in this country are generally made in the form of a cone, enclosed within a concentric case; there is one row of spikes on each side of the case, and four rows on the cone, placed at right angles to each other. The cotton is put in with the hand, by an opening right above the smaller end of the cone, and carried rapidly round until it is thrown out at the larger, by the centrifugal force.

The self-acting conical Willow, made by Mr. Lillie of Manchester, has been introduced into this country, and put in operation at Matteawan, New York; and Fall River, Rhode Island; but is not likely to be generally adopted; it altogether appears to be a heavy, clumsy machine.

There is another machine, called a Picker, used in a number of Factories in this country. It consists of a small cylinder, about 14 inches diameter, set full of short spikes : besides which there is a scutcher, or beater, combined in the same machine. The cotton is led into the picker by a pair of fluted rollers, having been previously spread upon a revolving cloth, or apron ; and after passing the picker and scutcher, it is forced up through a funnel, by a pair of fanners, to a chamber above. This machine is very injurious to the cotton, and likely to be laid aside.

A machine, called a Whipper, is also used in some Factories, and very highly spoken of. It is merely a substitute for the old mode of beating the cotton with switches, and consists of a flake table, or an oblong frame, the top or cover of which is composed of elastic cords, with two parallel shafts, fitted up with arms extending across above the cords, one shaft on each side of the frame, and moved by cranks, so as to make the arms strike alternately and rapidly upon the cords ; one end of the frame being higher than the other, the cotton is thrown in upon the cords at the higher end ; and by the operation of the arms, or reiterated strokes of the beaters, gradually passes down until it drops out at the lower : during this process of beating, the cotton is perfectly opened, and the seeds and dust drop down between the cords. The whole machine is covered with a kind of wicker work, to prevent the cotton from being thrown out by the beaters.

Another modification of the whipper has been lately introduced : the writer has had one of them

under his charge, and regards it as the best and simplest, as well as the cheapest machine of the kind he has yet known either in Great Britain or America.—*See Plate II. Fig. 1st and 2d.*—A B are two parallel shafts about  $2\frac{1}{2}$  inches diameter; *aaaa*, &c. are arms, or spikes, about six inches long, and fastened into the shafts. The shaft A is surrounded with a gird or harp from *c* to *c*, and the shaft B has a harp from *e* to *e*. The gird has several bars containing spikes pointed inwards; see *ssss*. The front of the machine is open from *b* to *b*; all the other parts of it are enclosed, except a small opening above, represented by the dotted lines *nn*: this opening is about  $2\frac{1}{4}$  inches, extending across the top, by which the cotton is introduced, when the revolving arms of shaft A immediately take hold of it and carry it rapidly round, and it is thus agitated and torn against the spikes *sss*; but as it proceeds round with the arms of the shaft A, it is met by the arms of the shaft B, which clear it off, and throw it out by the mouth *bb*. The belt pulleys G H are of different diameters, so as to make the shaft B revolve faster than A, by which means it has more power, and frees itself more perfectly of the cotton that becomes entangled between the arms of the revolving shafts. The diameter of the pulley G is six, and H seven inches, or the driving drum may be of different diameters, to effect the same variation in the speed of the shafts. The speed of the shaft B ought to be 1800 revolutions per minute, and A 1600; and as the shaft A has to carry round the greatest weight of cotton, it is generally rather stronger than B.

As the chief use of the willow is to open or separ-

ate the clotted tufts of cotton, so as to make it spread at the following machine ; the tearing process it must pass through to accomplish this is very liable to injure and break the tender staples; therefore every machine that has been employed for this purpose, is liable to many objections. The writer has been acquainted with almost all the different machines that have been in *general* use for the last thirty years, and he considers the whipper, represented in Plate II. as decidedly the best which he has seen. It is called Mason's Whipper, from the name of the inventor, and though of small dimensions, being only three feet high, and two and a half broad, it is capable of willowing one bale of upwards of 400 lbs. in an hour and a half. It occupies little room ; is easily managed and kept in order, and costs 75 dollars = £15 . 15 . 6.

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#### SCUTCHING AND SPREADING MACHINE.

IN the Cotton Factories of Great Britain, the above are generally two separate machines ; but in this country they are combined into one, denominated the lap spreader. In any of the British Factories where the two are combined into one machine, they have generally four or five beaters or scutchers; but here they have only one, two, or at most three.

There are three most essential processes in the cotton manufacture which, in the Factories of the United States, are not so well attended to as in those of Great Britain. First, in this country the

cotton is not so well mixed; second, it is not so well cleaned; and third, it is not so well carded. The first is done previously to its being willowed ; that is, a number of bales of cotton are mixed together, so as to incorporate their various qualities, and thereby obtain a large quantity of an equal and uniform quality. The method of mixing need not be here described, and the utility of doing so must be obvious to every practical manufacturer; but there is one great error which seems to pervade all the Cotton Factories in America, that is, to have too little room in their picking houses: few of those that I have seen have more than barely room for two or three bales of cotton, besides a willow and lap spreader. Now it is not uncommon in Great Britain to mix up from 20 to 30 bales into one heap called a bing or bin; and if there is any waste to be mixed with the cotton, there is ample convenience for doing so ; by which means a large quantity of cotton, perfectly uniform, and equal in quality, may be obtained. The Cotton being properly cleaned is of equal importance with its being properly mixed ; and the chief use of the scutching process is to clean it from all those seeds or vegetable substances that may have got intermixed with it, as well as to open out the tufts of cotton more perfectly than can be done at the willow, so as to make it spread more equally into a uniform lap for the cards. When all this is properly attended to ; when the cotton is uniform in quality, well opened and cleaned previous to its being put through the cards, the latter process will be more perfect. The great object to be principally attended to in spinning cotton yarn is, to make it equal in its

and are mostly all wooden cylinders covered with sheets : indeed, sheets are generally recommended even by those who have used fillets for the main cylinder.

In the Southern district, the general breadth of the cards is from 24 to 30 inches ; here there are some cast iron cylinders, but they are covered with sheets instead of fillets. The average speed of the cylinders in the two last mentioned districts is about 110 revolutions per minute, and diameter 36 inches. There are no carding engines in this country, as far as I have seen or learned, that are driven at so high a speed as those in England ; neither have I seen any that make work equal to that of the latter country. Indeed the manufacturers in England generally make superior work with single carding to any thing that I have yet seen in this country with double carding.

Fig. 2d represents the general form of carding engines used in Scotland, and for very fine numbers in England. In the former the breadth of cylinder is 24 inches, and diameter 36 ; the average speed of cylinder 120 revolutions per minute. When used to card for fine yarns, either in Scotland or England, the breadth of cylinder is 18 inches, and speed from 90 to 110 revolutions per minute.

Fig. 3d represents the general form of carding engines used in England for middle and coarse numbers. The breadth of main cylinder is 36 inches, and diameter 42 ; diameter of doffer 18 inches ; speed of main cylinder, from 130 to 150 revolutions per minute. The cotton is taken in from the feeding rollers by the licker-in roller A, from which it is transferred to the main cylinder, and again carded

between the cylinder and the carding rollers B and C, both of which revolve with a slow motion. Whatever cotton adheres to B is cleaned off by A, which acts both as a licker-in and cleaner to B. The carding roller C is cleaned by D. These are technically denominated carders and cleaners: in this country they are called workers and cleaners. The relative surface motion of the main cylinder, and A and D, should be as three of the former to two of the latter, that is, the surface of the main cylinder should move through a space of three inches, in the same time that A and D move two. The English carding engines are generally mounted with a drawing head called a drawing box, represented at F, figures 3d and 5th, the two under back rollers of which are slightly fluted, and the upper ones covered with a ply of cloth and leather. The two front ones, being the delivering rollers, are quite smooth, without any covering. The cotton, as it is delivered from the doffer in a thin fleece, is conducted into the back rollers, where it is drawn between that and the middle rollers, about  $1\frac{1}{2}$ , or 2 to 1, and again compressed by the conductor e, from which it is delivered by the front rollers into the can. Whilst a number of English Factories have the card ends delivered into cans, there are others which have the ends from several cards wound on large wooden bobbins, with tin-plate ends: these bobbins when full, are carried direct to the first heads of the drawing frame. Those who use two sets of cards generally retain the old lap-drum in front of the breakers, from which the lap, when sufficiently thick, is broken off, and placed to the

back of the finisher. In the Factories in Scotland, as well as in this country, it is common to have a separate machine between the breaker and finisher cards, for the purpose of forming laps for the latter: this is called a lapping machine or lap doubler.

Fig. 4th represents a particular form of carding-engines used in various Factories in Great Britain, which for single carding, is, perhaps, the best with which the writer is acquainted, as the flat tops are here placed in the most convenient position for being frequently stripped: and whatever impurities may pass in with the cotton, will be held fast by the first tops, from which such impurities will be removed by the top stripper, before they get intermixed with the carded cotton. The roller G, denominated the fancy roller, is driven so as to outrun the main cylinder, by which means the cotton that adheres to the surface of the main cylinder is slightly raised up, and again straightened by the carder E, before it is thrown on to the doffer: this continual operation of the fancy roller keeps the cylinder always clean, and thereby supersedes the necessity of stripping it more than once every second day or so. This not only saves time and waste, but makes better work, as every practical carder knows that when the cylinder is full of cotton, the carding is not so clear and uniform as immediately after stripping it; therefore, by keeping it always clean, the carding is uniformly good. The fancy roller requires to be covered with filleting, having longer and finer wires than that which is used for any of the others: the wires ought likewise to be set nearly straight, having only a slight bend, so as to prevent it from carrying round

the cotton with its accelerated motion. The back of the wires on the fancy roller being towards the back of those on the cylinder, very little cotton adheres to its surface; besides, the cleaner H may be placed so as to act as a cleaner to both E and G, and thereby prevent the cotton from collecting on either.

Fig. 5th represents a species of carding engines used about Oldham, (England), called double carding engines, which are certainly the most powerful machines of the kind which I have yet seen. They are similar to those used in Woollen Factories, and found equally applicable to the cotton manufacture. This machine, as may be seen by the sketch, consists of two complete carding engines combined, the main cylinders of which are surmounted with small cylinder cards instead of flat tops. These latter are known amongst practical manufacturers by various names. They are called urchins, squirrels, carders and cleaners, or workers and cleaners. The breadth of cylinder is 48 inches, diameter 42, and the speed at which they are driven, is from 160 to 180 revolutions of main cylinders per minute. This may appear incredible to some, but the writer had full opportunity of ascertaining the fact by personal observation. The intermediate doffer A is about 28 inches diameter, and revolves once for every ten revolutions of first main cylinder H. The second doffer B, is about 22 inches diameter, and revolves once for every twelve revolutions of second main cylinder E. The quantity of yarn produced is from eight to nine cwt. per week of 69 hours, from each of these double engines, No. of yarn 36; equal to 155 lbs. of No. 36 per day, of  $11\frac{1}{2}$  hours. The feeding rollers G, instead of be-

ing fluted, are covered with filleting half an inch broad, and made with strong wires, formed with what is called the diamond point. Indeed, all broad carding engines, that is, all above 24 inches, ought to have a pair of small cylinder cards, from two to three inches in diameter, instead of fluted feeding rollers. The teeth of these small cylinders should be pointed inwards, so as to operate as lickers-in; and instead of feeding the cotton immediately on to the cylinder, they should be surmounted by a larger cylindrical card, for the purpose of transferring the cotton from them to the main cylinder. Every practical carder knows that when weights are suspended on each end of a long feeding roller, it will spring up in the centre so much, as partly to lose hold of the lap, and instead of the cotton being fed on to the cylinder in single filaments, it will be pulled in by the card teeth in large tufts, thereby producing bad carding, and of course inferior yarn; and to enlarge the diameter of the feeding rollers with a view to prevent the spring in the middle, is attended with an equally bad effect; for by that means the bite of the rollers will be too far off the surface of the cylinder; as the nearer the bite of the feeding rollers is to the card teeth, the better. The distance between the points of the card teeth, and the bite or centre of the feeding rollers, ought to be rather less than the length of the staple; by that means the wires will take hold of each filament separately, and carry it up to the tops immediately as it escapes from the rollers. Practical carders are aware, that when thick feeding rollers are used, the cotton, instead of being taken off by the card cylinder in

single filaments, will stand up, as it were, in flakes having a fringe-like appearance, between the upper roller and the surface of the cylinder, and either adhere to the roller, or go off in tufts with the card teeth; and as the principal use of the carding process is to separate or divide the fibres of the cotton, and straighten them to a certain degree, so as to form an evenly sliver, it is of essential importance to the attainment of good carding, that a proper method of first introducing the cotton into the main cylinder be well understood; and here it may be proper to notice the difference between the practice of the United States and that of Great Britain. In this country, it is common to crowd the cotton on to the cylinder so rapidly, that, instead of being taken away from the feeding rollers in single filaments, it is dragged in by the slow motion of the revolving cards in large flakes, which are not allowed to remain long enough under the operation of the tops, to be sufficiently teased out, the doffing cylinder being also driven too fast in proportion to the speed of the main cylinder. Now the practice in Great Britain is directly the opposite of this: there the cotton is led into and delivered from the cards, by a very slow motion; that is, the motion of the feeding rollers and doffing cylinder, are comparatively slow in proportion to the speed of the main cylinder; as, for example, the mode of regulating the motions of carding engines is as follows: in Britain a main cylinder 36 inches diameter, will revolve between 70 and 80 times for one of the feeding rollers: in this country their motions are as 35 of the former to one of the latter. The proportion between the revolu-

tions of the main cylinder and doffer are in Britain as 25 of the former to one of the latter. In America, it is as 17 to 1.

From the above it may be very easily perceived how the American manufacturers do not generally produce yarn of equal quality to that of the British. In the first place, they do not mix a sufficient quantity of cotton at the first process: and secondly, they do not clean it so well at the scutching; neither is it so well carded. The British manufacturer makes the cotton undergo a greater amount of operation, both at the scutching and carding, and hence he is enabled to produce a cleaner, smoother, and more evenly thread of yarn, than that which is generally produced in America. In order to make smooth level yarn, it is therefore absolutely necessary to have the cotton well cleaned and carded: if the tufts or knots of the cotton, are not perfectly teased out, and the fibres well separated at the latter process, the fleece delivered from the doffing cylinder will exhibit inequalities, or appear what is technically denominated "*clouded*," and from card ends of that texture, it is impossible to make good yarn. I am aware that bad carding will frequently arise from inaccurate adjustment of the operating parts of the machine, but at the same time, if the *principle* upon which the various processes are conducted be wrong, the most perfect adjustment of the machinery cannot remedy the evils arising therefrom. It has been already stated, that the English spinners make their cotton undergo more operation at the carding process than the Americans; and in order to produce a sufficient quantity of work, they also drive their

cards at a much higher speed. While a cylinder of 36 inches diameter moves at the rate of 100 to 110 revolutions in the American Factories; in England a cylinder of 42 inches diameter, and of the same breadth, revolves from 130 to 160 times; which, taking into consideration the difference of their diameters, is *nearly* double the speed of the former.

Before leaving this subject, it may be proper to notice, that the manner of attending and managing the carding engines in this country, is different from that of Great Britain. Here the cards, &c. are not divided into what is called systems, or preparations; nor is the mode of stripping and grinding the same. In Britain, one person strips the cylinders, and another the tops: and as a regular system of stripping is of the utmost importance, the top stripper is therefore kept constantly going round a certain number of cards, of which he or she may have the charge, which number generally constitute a system or preparation: but if these be too many, they may be divided, so that one person may strip the breakers, and another the finishers: and suppose the cards to have twelve working tops, the stripper proceeds in the following order. Beginning at the one end of the range of cards, the first four tops are stripped all round the system or preparation: again, commencing at the first card, the second four, or the 5th, 6th, 7th, and 8th tops, are stripped all round in like manner; this completes two courses, wherein the first eight tops have been stripped once: in the third course, the first four tops are again stripped, and at the fourth round, the last four, or the 9th, 10th, 11th, and 12th, are stripped:

thus the stripper takes four courses to go round all the tops ; during which the first four have been stripped twice, and the other eight only once. The preceding is the order of stripping the tops for coarse numbers ; for middle numbers, only two, or at most three tops, should be stripped at each course, carefully observing to strip the first two oftener than any of the others : for fine numbers no more than two should be stripped at each course. In some Factories the whole of the tops are stripped in three courses, in the following order. In the first course, the stripper cleans the 1st, 4th, 7th, and 10th : second course, the 2d, 5th, 8th, and 11th : and lastly, the 3d, 6th, 9th, and 12th. If there are more than twelve tops, the order of stripping is so arranged as to secure uniformity of work. But it is an invariable rule, that as soon as the whole of the tops have been stripped all round, the stripper immediately commences to go over the whole series of cards in the same order as before ; thus keeping up a constant and uniform system of stripping during the whole time the machinery is in operation. The cylinder stripper has also a certain number of cards assigned to him, which he is careful to strip at least every two hours, so that the top stripper is left at liberty to proceed with his work without interruption, and is paid by the weight of strippings taken off; which strippings are weighed and examined every day by the overseer, or some other person appointed to do so.

In the American Factories the order of stripping is very different from that described above, particularly in the Eastern district. Here, the stripper

having charge of a certain number of carding engines, begins at the first card in the series, and strips every second top all over, that is, the 1st, 3d, 5th, 7th, 9th, and 11th; and having gone over the whole of the cards in the set in this manner, he is allowed to rest a certain time, say fifteen minutes, before he begins his second course, which embraces the 2d, 4th, 6th, 8th, 10th, and 12th tops: thus the whole of the tops are stripped in two courses, and at the end of each, he is allowed to rest about fifteen minutes: but as it is left to the stripper himself to notice the expiration of the fifteen minutes, the utmost punctuality is not to be expected, as the overseer, however attentive, cannot always have his eyes upon him. The top stripper likewise strips the cylinders, and during this process he must either stop all the cards under his charge, or allow them to run without stripping, which is too frequently the case. And supposing him to have the charge of ten cards, it will sometimes take 30 minutes to strip the whole, the tops being stripped all over with the cylinders as he goes along: and if the cards have been kept running all the time, they will thus have been working full 30 minutes without stripping: it is therefore not to be supposed that perfect work will be produced from such a process. The strippers are generally paid by the day, not by the weight of strippings taken off; as owing to the frequent changes amongst the hands in this country, it is difficult to establish a system of piece work in some departments, which can be done with the greatest convenience in Great Britain.

The mode of grinding or sharpening the cards in

this country, is very different from that of Great Britain. In the latter country, when a carding engine is first clothed with new sheets, fillets, &c. the practice is to put the cylinders in motion the right way; and a light emery board about four inches broad, is traversed over the top of the cylinders with a very delicate hand: this is called facing up the teeth, because the points of the wires are running against the board, and is intended to cut down any single wires that may be too long. After running the cylinders in this way for about fifteen minutes, their motions are reversed; and small cast iron cylinders coated over with No. 4 emery, are mounted on the top of each cylinder, that is, one above the main cylinder, and one above the doffer: these are denominated fast grinders; and which, after being properly set, are caused to revolve in an opposite direction to the card cylinders. This operation is continued until the whole of the teeth on both cylinders are ground down to one uniform length; but during the process of grinding, the emery cylinders are made to traverse a little each way, so as to grind the wires to a round point, and prevent them from being hooked or barbed. After being sufficiently ground, the cards are then dressed up, first with a brush dusted with chalk, and then with emery boards called straikes or strickles; this latter process is called sharpening, and is afterwards continued daily, at least once every day to the breakers, and every second day to the finishers. But the fast grinders are not applied perhaps above once a year, or only when the cylinders are found what is called "off the truth;" that is, when some part of their surface may have become

higher than the other parts ; then the grinders are employed to reduce all to the same level. By this method of grinding the cards only when necessary, and sharpening them every working day, they are always in good order, and consequently produce more perfect work : besides, when the practice of sharpening is continued daily, it can be done in much less time. Two hands are quite sufficient without much exertion, to sharpen thirty carding engines in the space of four hours, the card belts being all fitted up with buckles, so that no time is lost in shortening or lengthening them for the purpose of reversing the motion of the cylinders. The tops are also brushed out and sharpened once every week.

Now the practice in this country differs from the above in this respect, that the cards are never sharpened except when they are ground ; or rather, the grinding and sharpening constitute the same operation, which is repeated only once every two, three, or four weeks, and is done in the following manner. One fast cylinder grinder is placed between the main cylinder and the doffer, so as to grind both at the same time ; and after being allowed to operate in this way for one or two days, it is removed, and the cylinders dressed off,—not with emery boards, but strickles made of belt leather, coated with emery in the same manner as the boards ;—when the card is in this way sufficiently sharpened, it is put in operation, and allowed to run a week, a fortnight, or a month, and perhaps longer, before the same operation is again repeated ; the tops are also brushed out and sharpened at the same time.

The preceding is the general mode of grinding

and stripping the cards in all the Factories of at least the Eastern district; but whether the practice of the Southern Factories is the same, the writer has not had sufficient opportunity to ascertain: according to information, however, it appears that the manufacturers in the Southern States follow the practice of Great Britain in the general details of their works so far as practicable.

The clothing for carding engines, that is, sheets and fillets, are all made with machinery in this country, and are as good as those in Great Britain; the leather, however, does not appear in general to be quite so well tanned; yet they last as long, if not longer: from five to seven years may be about the average time allowed for one clothing. Many of the spinners in Great Britain renew their card clothing every three or four years, especially those who spin fine numbers: the old sheets are sold to coarse Factories.

Plate IV. represents a system of carding introduced at Matteawan, in the State of New York, the chief peculiarities of which are the following: the feeding rollers A, and the doffing cylinder B, are both considerably below the centre of the main cylinder; so that a greater portion of the latter is in actual operation. In the common system of carding, a little more than one-third of the surface of the main cylinder may be said to be in operation at one time; but in the Matteawan cards about two-thirds. D D are not doffing cylinders, but carding rollers, at the back of which there are small cleaners, one end of which is seen at E.—F F are standards supporting a drawing head. C is a horizontal box,

called a railway, along the bottom of which the belt G moves with a slow motion, proportioned to the delivery of the cards. The fleece of cotton delivered by the doffers B B descends down to the railway box C, where it is compressed by the small rollers H H, and carried forward by the belt G, until it reaches the back of the standards F F, where the railway terminates, and from which the fleeces delivered from each card in the set, being compressed into slivers, are drawn up in regular order to the drawing head J, where they undergo a draught regulated according to circumstances, and then delivered into a can. In the plate only four cards are represented in connection; but it is obvious that any number from two to sixteen might be connected in the same way, and the drawing head, instead of standing in front of the cards, could be placed at one end of the range; so that the railway might run along in front of the whole.

The railway system is extensively adopted about Rhode Island and other parts of the middle and Southern districts. The writer has seen sixteen cards all in one line delivering into a railway, having the whole doffing cylinders and feeding rollers connected, and driven by the same motion, whilst the main cylinders were driven separately; so that the whole feeding and delivering motion could be instantly stopped, or put in operation, without affecting the motion of the main cylinders.

The above, or railway style of carding, was put in operation in Glasgow, by Mr. Niel Snodgrass, in 1835; and although the writer has seen it in a number of Factories in various parts of America, yet he

has no hesitation in saying, that the manner in which Mr. Snodgrass put it in operation, was altogether the neatest and most perfect of any that he has yet seen. He had eight carding engines, all delivering into one railway, one or more of which could be stopped when it was necessary to strip or grind, and as soon as the broken off sliver entered the drawing rollers at the end of the range, the person attending them, by means of a small shifting lever, threw one pair of pinions out of gear, at the instant another pair was put in operation, which diminished the draught exactly in proportion to the number of cards stopped. All this was done without interrupting the progress of the work: and the sliver delivered into the can from the drawing head, was of the same grit as when all the cards were running. The Matteawan carding engines have the same means of shifting various pinions in and out of gear, for the purpose of increasing or diminishing the draught in the drawing head J, to suit the number of cards stopped or in operation. In some Factories this is accomplished in a very imperfect manner by means of a pair of cones: in others one or two spare carding engines are kept standing all the time, except when an equal number are stopped for being stripped or ground.

The only advantages of the railway style of carding, are the saving of one or two hands, whose wages are generally the lowest paid in the whole Factory, and the superseding the use of a number of card cans; but at the same time it produces a great deal of very imperfect work. Every practical carder knows that the card ends frequently break down in front

of the doffer, in consequence of some interruption at the feeding, as well as from many other causes : and when this occurs with those delivering into a railway, it makes a want or deficiency in the grist of the sliver carried forward to the drawing head, and ultimately a weak part in the yarn. But the same objection will equally apply to the English system of making the ends from several carding engines wind on to a large bobbin for the purpose of being set up at the first heads of the drawing frame. When each card delivers into its own can, any inequality in the sliver can be more easily removed, so as to secure more perfect work. Great care should be taken, however, not to press the cans too hard, as the slivers being very soft and tender at this process, will certainly stretch when being pulled out of a can that is hard pressed. A method of pressing the card ends into the cans has been introduced into various Factories in Scotland with very good effect. It consists of having the can placed with the bottom upwards, upon a round plate of iron, with a small hole in the centre ; this is placed about six inches off the floor, having a pair of calender rollers right under it, which are moved by an upright shaft ; this shaft is driven by small bevel pinions on the delivering shaft of the card, so that the calender rollers of the card have the same motion as the under ones ; and the card end, as it is delivered from the calender, or delivering rollers, descends to those under the iron plate, and being directed by a tin conductor, is made to pass up through between the under rollers, which are pressed together with a spring, and by them through the hole in the centre of the plate into the

can. Thus the can is filled upwards: and being furnished with a loose or false bottom, which lies down upon the plate when the empty can is placed there to be filled, but rises gradually as the sliver is pressed up into the can; and when the can is full, the loose bottom has reached the top, where, by disengaging a catch, it causes a spring to ring a bell for the purpose of apprising the card tenter, who immediately removes the full can, and replaces it by an empty one to be filled in like manner. Those cans that are pressed in this way contain a great number of card ends, which, from the gradual manner in which they have been filled, are easily drawn out without stretching.

It has been already stated, that the preparation machinery in the American Factories, is not divided into systems, or preparations, as in those of Great Britain. In general, every Factory in this country is calculated and fitted up for making only one kind of goods, and the warp and filling\* being made from the same cotton, undergoes the same operation; whereas in the British Factories, there are generally various qualities of goods manufactured at the same time; so that the waste made from the finer, may be used up in the coarser; and the warp and weft are always made from different qualities of cotton. Weft does not require the same quality of cotton as the warp; neither does it require the same expensive process: and it would be attended with considerable profit to the manufacturers of this country, if they had sufficient room in their picking houses to make at

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\* Weft in this country is always called filling.

least two mixtures of cotton, one for warp and another for filling, by which means all the waste used could be put into the filling, thereby leaving nothing but good cotton for the warp; as the latter requires to be strong, smooth, and wiry; whilst the former requires to be soft and woolly, so as to fill up the cloth, and give it a more rich and full appearance. When waste is put into the filling, it imparts to it this rough and woolly quality; and when prepared in a separate system of cards, drawing, &c. the process could be abridged and better adapted to the quality of yarn required.

The manufacturers of this country generally use up a considerable portion of the inferior waste into what is called batting, that is, after being spread into a card lap in the usual way, it is put through a breaker card, which is mounted with a lap drum; and when the carded lap has acquired a proper thickness, it is broken off from the drum, and rolled up in paper for the purpose of being sold to country people, or others who may want it, to be afterwards sewed between two plies of cotton cloth, and used instead of blankets. These are then called comforters, and are extensively used in this country both by rich and poor; one good one is certainly superior to a pair of Scotch blankets: and when neatly covered with printed calico, quilted, and bound round the edges, they appear extremely neat and cleanly upon a bed. It is somewhat surprising that these comforters are not,—at least so far as known to the writer—used in Great Britain; as poor people might thus have good warm bed clothing much cheaper than woollen blankets.

Double carding, or breaker and finisher cards, are generally used in all the American Factories, as formerly stated, and between the breaker and finisher, there is a separate machine employed for making laps for the latter, denominated a lapping machine, or lap doubler, which, though used for the same purpose, is made upon a very different construction from those now in general use in Scotland, but is not deemed of sufficient importance to merit the expense of a separate plate. All that is considered necessary in this place, is to endeavour to describe the difference between the two.

The lap doublers used in the Cotton Factories of Scotland, require to have double or treble rows of cans crowded behind the machine; and the card ends, from these being guided by proper conductors, are directed through between a pair of calender rollers, from which they are then wound on to the lap roller for the finisher cards. Those used in this country, have a long frame stretching out about seventeen or eighteen feet behind the machine: this frame is mounted with wooden rollers for the purpose of carrying forward the card ends from the cans, which are stretched out in one row along the angled side of the frame; the card ends are brought forward in regular parallel rows between the wooden rollers, till they reach the calender rollers, where they pass through the same operation as the above. But each end as it comes out of the can, passes through a guide or conductor, called a latch, which is so constructed, that when an end breaks or runs out, the latch drops down; and as it drops, it touches a pin fastened into a horizontal rod lying along one

side of the frame, and causes the rod to turn round so far as to disengage a catch at the head of the frame : the disengaging of this catch allows a spiral spring to operate upon the belt lever, so as to shift the belt from the fast on to the loose pulley, by which means the machine instantly stops. Thus when an end breaks or runs out, the machine stops instantly, until the attendant repairs the broken card end, and lifts the latch to its proper place. The writer is not aware of any such machines in Great Britain being fitted up with a similar contrivance ; so that when an end breaks in those used in that country, it is wholly left to the attendant to stop the machine, or piece up the broken end while running : and practical carders know the difficulty of always obtaining correct work at this process.

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## DRAWING FRAMES.

THE Drawing Frames used throughout the Eastern district are made on the same plan as those generally used in England, and consist of a single beam with three pairs of rollers, each frame containing only three single heads. The draught on each head is divided between the middle and back, as well as between the middle and front rollers. Some of those frames which are made about Providence in Rhode Island, have double roller beams ; but none that I have yet seen, are equal to those now made in Glasgow, (Scotland.)

The drawing is a most important process in the

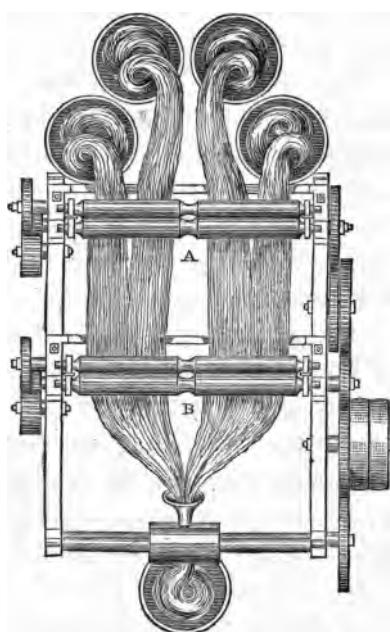
art of cotton spinning, and requires to be arranged with great skill and attention, so as to give the slivers that amount of doubling and drawing that is just necessary, and no more ; at the same time the slivers ought to be kept as heavy as possible, until they pass through the fly frame where they are twisted. Now, so far as I have had an opportunity of ascertaining by visiting Factories or otherwise, I do not find that the manufacturers in this country double the slivers so much as is done in Britain. And in many Factories the slivers are as fine as in those of Manchester, that manufacture from Nos. 150 to 200. This must, therefore, be attended with very injurious effects ; as owing to their extreme softness and delicacy, they require to be very tenderly handled ; and, indeed, it is almost impossible to pull a fine sliver out of the can without stretching it; hence the necessity of keeping them as heavy as can be done with safety, at every department of the process.

The drawing frames of this country, that is, those with the single beam of three pairs of rollers, are made upon the most simple plan ; yet they are not so well adapted for making good work as those with a double roller beam ; because when the sliver is drawn between a pair of rollers, it spreads out, and becomes thin and broken at the edges. Now, in a three roller beam, where the draught is distributed between the middle and back, as well as the middle and front rollers, the first draught spreads out the sliver to a certain extent, whilst the second causes it to spread still farther : and when it is delivered from the front rollers, the edges or selvages

of the sliver are so thin, that they become ragged and broken, and the fibres or filaments losing their hold of each other, double up, and adhere to the upper front rollers, by which they are carried up to the cleaners, and there collect in large tufts, which, besides making waste, causes a great deal of very imperfect work. I have never known the drawing frames in Great Britain cause so much trouble as those with which I am acquainted in this country, in consequence of the slivers adhering to the upper front rollers. If the same evil is general in all the Factories, and I know it is in a great many, I am not surprised that the manufacturers of this country have not as yet attained to great perfection in the *quality* of the goods manufactured. Besides the cause above stated, viz. the double draught in the single roller beam, there is another, which I have no doubt operates in some measure to produce the same effects, that is, the quantity of electricity generated in the carding rooms. It was formerly stated that the spinning frames were generally driven from the carding room, by means of belts passing up through the floor; this, of course, causes a great number of carrying belts in the card room: and these belts produce a great deal of electricity, more so than anything of the kind I have ever witnessed in any Factory in Great Britain. At certain times the loose fibres lying on any part of the machinery under these belts, will all be standing up on one end, pointing to the belts, and a small tuft of cotton held by the hand, within two feet of the belts, will, as soon as let go, fly straight up, until it strike the belt, and then fall down to the floor. If a piece of

pointed steel is held up to these belts, a current of sparks will instantly issue from its point towards the belt, accompanied by a snapping noise, and at times, the same effect will take place by holding the fingers close to the belt, whilst a certain twitching is experienced, being a succession of slight shocks. But whether the same effects would be produced by rapidly revolving belts in the Cotton Factories of Great Britain, I am not prepared to say, as I never experienced anything of the kind, at least to the same extent as I have done here. One thing is certain, that the climate of this country is much drier than that of Britain ; and it is always observed, that the air here becomes more highly charged with electricity in very dry weather, particularly before rain. On some occasions it is so much so, as to effect the work considerably in the carding rooms, and especially the drawing frames. I have seen in one room about twelve frames, and not one of them working properly, but all, more or less, lapping up on the upper rollers, and making a great quantity of waste, besides spoiling the work. But this may be greatly remedied by the double roller beam, such as that represented in the annexed figure. Here the slivers in passing through the back beam A, undergo a draught of 2, or  $2\frac{1}{2}$  to 1 ; and as it, (the fleece or reduced slivers) is thereby caused to spread out, it is again gradually contracted as it proceeds from the front roller of the back beam, to the back roller of the front beam B, by which means the thin edges of the fleece are caused to double over ; and entering the front beam in that state, where it undergoes a draught of 3 or upwards, it is again delivered from

the front rollers with smooth unbroken selvages, being equally as thick at the edges as in the centre; and the fibres having hold of each other, are not so liable to double up, or lap on the front rollers.



Although only four card ends or slivers are represented as passing through the head in the figure, it is obvious that six or eight may be put up, according as might be thought requisite.

I have already stated, that the drawing frames in this country have generally only three heads, by which the cotton is what is technically denominated three times drawn, that is, made to pass three times through the drawing frame. Now in Great Britain,

the drawing frames are made with six, eight, or ten drawing heads, according to the number of times the slivers are to be drawn. For three times drawing, the frame will have six heads paired, two and two : for four times drawing, there will be eight heads, and ten heads for five times drawing. Five times drawing, however, is only used for very fine yarns ; four times for middle numbers ; and three times is deemed sufficient for all low numbers, whilst the number of doublings is often a mere matter of opinion : in all Factories there are more or less, according to the peculiar notions or experience of the superintendents, or the quality of the yarn wanted, and the cotton from which it is to be made. I have often found that too many doublings and drawings had a greater tendency to injure the yarn, than improve it ; and I believe it is generally admitted, that the less operation the cotton passes through at this department of the process, it is the less liable to injury ; hence every experienced manager of Factories studies to give just what is necessary and no more.

The drawing frames in this country having three single heads, require two girls to attend them, whilst one in Great Britain, with six heads, and driven at the same speed, requires no more. Thus a drawing frame in the latter country, being double the size, produces double the work with the same number of hands.

A striking peculiarity in the drawing frames of this country, viz. their self-acting stop-motion, so far as I am aware, has not yet been introduced into the Factories of Great Britain, nor do I believe it neces-

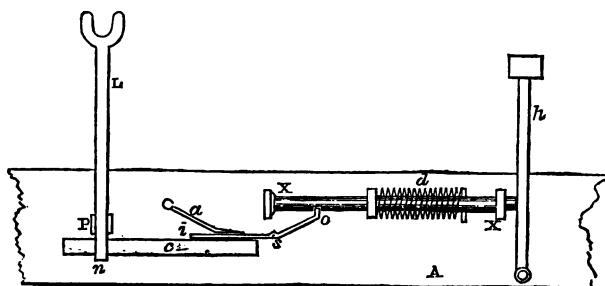
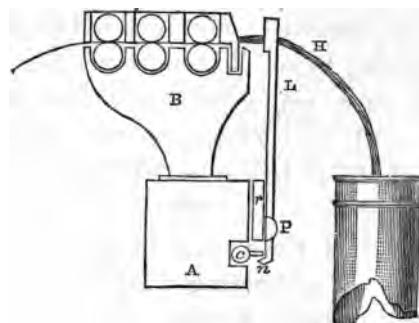
sary that it should; because the helps\* in that country are very different from those in this. Here they are constantly changing, old hands going away, and new ones learning. The great majority of girls employed in the American Factories are farmers' daughters, who come into the Factory for, perhaps, a year or two, and frequently for but a few months, until they make a little money to purchase clothes, &c. and then go home. In consequence of this continual changing, there are always great numbers of inexperienced hands in every Factory: and as the drawing process requires the utmost care and attention to make correct work as well as to prevent waste, it is necessary to have the most expert and experienced hands attending the drawing frames; but this cannot always be obtained in this country as in Great Britain; hence it is more necessary to have some contrivance connected with the machinery here, which will, to a certain extent at least, prevent the work from being injured by inexperience on the part of attendants. All the drawing frames, therefore, which I have seen in this country, are mounted with a self-acting stop-motion, so that when an end (sliver) breaks, or runs out, that head with which it is connected instantly stops.

The annexed figures represent the stop-motion; A A is the wooden beam, supporting the stand B, with the drawing rollers: L L, called the latch, is supported by a pin P P, upon which it is so nearly

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\* The work people in Cotton Factories, as well as house servants in this country, are *always* called "helps;" upon no occasion do we ever hear them designated *workers* or *servants*.

equipoised, that it requires only the weight of the sliver H to make it stand upright; but as soon as the sliver breaks, it falls down, and the under point *n n* touches a small pin projecting from the rod *c c*, which causes it to turn partly round, and in turning round, another projecting pin presses up the catch *i*; this catch turning on the stud *s*, the point *o* is brought down, and thereby relieves the rod *X X*, which is immediately forced forward by the spiral spring *d*; and striking against the belt lever *h*, causes it to shift the belt from the fast on to the loose pulley; by this means the head is instantly stopped before the end of the broken sliver enters into the back rollers. The small steel spring *a*



presses slightly on the catch *o s i* at *i*, and thereby keeps the point *o* in its place. The whole of this apparatus except the latch *L L*, is concealed when the frame is in operation, between a piece of wood *r*, and the beam *A*.

The stop-motion is entirely an American invention, and is particularly necessary in this country for the reasons already stated. But besides the expense of fitting up, it is very liable to get out of order, and when that is the case, it makes a great deal of imperfect work, as it usually begets carelessness on the part of the attendants, who depend almost entirely upon the latch for stopping the head when the work goes wrong ; and when one latch falls, it frequently brings down others, and breaks or injures the slivers, besides causing some trouble in putting them all right before the head can be again started. Now in Great Britain where there is always a command of experienced hands, the introduction of this stop-motion would be attended with no advantage, as, in my opinion, two active girls by close attention, would do more and better work on a drawing frame having no self-acting stop-motion, than any I have yet seen with it, even the most improved.

## SPEEDERS.

THE first machine which follows the drawing frame is in this country usually denominated a “Speeder,” and of these there is some variety; as for example, the Taunton Speeder, the Double Speeder, the Eclipse Speeder, and the Plate Speeder. All these are entirely American inventions. The first, *viz.* the Taunton Speeder, takes its name from the place where it was first put in operation, Taunton, in the State of Massachusetts, a place where there is a great deal of very superior machinery made. This machine was patented in England in 1825, by Mr. Dyer of Manchester, and is known by the name of Dyer’s Frame. They are also made in Glasgow, by Mr. Holdsworth, and Messrs. William Craig & Co. (late C. Girdwood & Co.) where they are known by the name of tube frames. Though the principle of these frames is the same in both countries, at least in as far as the tube is concerned; yet those that are made in Britain are so much improved in their general form and construction, as to render them altogether a very different machine from anything of the kind which I have yet seen in this country; indeed, so far as I have learned, the Taunton Speeder is rather an unpopular machine in this country, and is likely to be entirely superseded by others of a much superior character.

The tube frames made in Glasgow have generally two rows of bobbins in one frame; those of this country have only one row: and in the various Factories which I visited in England in 1836, I do not re-

member having seen any of Dyer's frames with two rows of bobbins. Hence those now made in Glasgow are altogether the best that I have yet seen, and are well adapted for spinning any numbers of yarn under No. 36.

The Eclipse Speeder, or, as it is sometimes called, the Bellows Speeder, was introduced into Manchester in 1835, where it is known by the name of the Eclipse Roving Frame; a short description of which is contained in the "Theory and Practice of Cotton Spinning." The rovings produced from this frame are in every respect the same as those from the tube frame, having no twist, and built on the bobbins, or spools, with conical ends in the same manner. Instead of the roving passing through a tube, as it descends to be wound on the bobbin, it passes through between two opposing surfaces of a travelling endless belt, which produces the same effect. In the quality of the roving, it has no advantage over the tube frame, but it is much more simple in its construction, occupies very little room, and requires much less power to work it; whilst, at the same time, its power of production is astonishingly great. The front roller, being  $1\frac{1}{4}$  inches in diameter, may be driven at the rate of from 700 to 750 revolutions per minute; and a machine, therefore, of ten bobbins, the size generally made, will produce 40 to 50 hanks of roving per hour, allowing for time to remove and replace the bobbins or spools as they are filled.

The Eclipse roving frames are made by Messrs. Sharp, Roberts & Co., of Manchester, by whom they have been much improved, and made altogether very superior to those used in this country.

The Plate Speeder was introduced into Glasgow in 1835, by Mr. Neil Snodgrass, who imported one direct from America. The general form or construction of this frame is similar to that of the tube frame, only in place of tubes, there are friction plates; and each ply of roving, as it proceeds from the front rollers to the bobbin, passes through between one pair of these plates, which, revolving rapidly in opposite directions, twist and untwist the roving exactly in the same manner as the tube. The whole surfaces of the plates are not in contact but only about one-half inch from their periphery, which part is beveled off so as to make those sides of the plates nearest the front rollers stand about  $1\frac{1}{2}$  inches apart, in order to bring the two surfaces of the beveled portion exactly parallel to each other. The plates are therefore placed so as to form an acute angle; the acute point of which, pressing on the bobbin upon which the roving is wound, makes it wind on as firmly and compactly as if done by the tube. That portion of the inner surfaces of the plates which are in contact, are slightly grooved or fluted, so as to operate more effectually on the roving, and they may be set closer or farther apart, as may be thought necessary, by which means they are equally adapted to coarse or fine roving, as well as to dirty or clean cottons.

The Plate Speeder, whilst it possesses all the merits, and obviates many of the defects of the tube frame, is not considered equal to the eclipse speeder, either in the quantity of work produced in a given time, or in simplicity of construction.

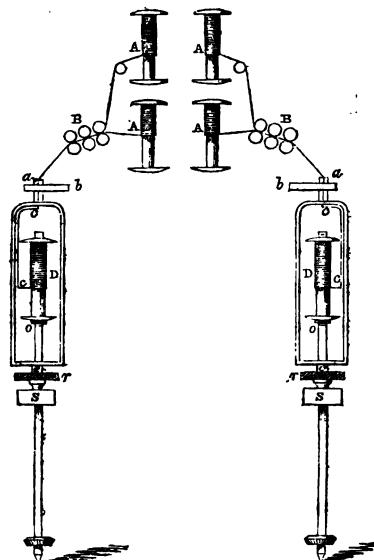
The Double Speeder is properly a fly frame, but

differing very materially in its construction from those generally used in Great Britain. It is considered the best in this country, and is more extensively used than any of the three already mentioned. I am not aware, however, that it has ever been introduced into Great Britain, nor do I think it would succeed there ; as, with all its merits, it cannot be compared with the fly frames now made in Manchester and Glasgow. As regards the quality of the roving produced, it is equal to any fly frame I have yet seen ; but it is heavy, clumsy, and extremely complex. The fly frames of Great Britain have all two rows of spindles, whilst the double speeders of this country have only one ; yet one of the latter with twenty spindles will require double the power to move it, and consume double the quantity of oil required for one of the former containing forty-eight spindles : at the same time, the English fly frame will produce much more than double the quantity of work.

The double speeder is made in two different forms : the first of which is that which receives the cans direct from the drawing frame, and has only one row of spindles on the one side of the frame ; these are usually called speeders : the other receives the bobbins from the speeder, and reduces the rovings to a finer texture, and is denominated a stretcher or extenser : these have one row of spindles on each side of the frame similar to that of the common throstle or spinning frame.

The figure on the next page represents the exact position of the spindles and bobbins in the extenser. The bobbins A A A A having been filled at the

speeder, are here mounted on a common creel containing four rows; and one ply of roving from the upper and under bobbins being doubled, they pass through the beam rollers B B, where they undergo a draught of from 5 or 6 to 1; from these the reduced rovings are delivered to the flyers, and entering the funnel at *a a*, they descend the tubes *c c c c*, from the bottom of which they are wound on to the



bobbins D D, which, when full, are removed and carried to the spinning frames. By examining the figure, it will be seen that the front rollers are lower than the back ones; this is called the bevel of the rollers. All the frames of this kind, as well as the spinning frames, have the rollers more or less beveled, as by that means the twist from the flyers proceeds direct up to the bite of the front rollers.

It likewise shortens the distance between the top of the flyers and the rollers, so that the yarn or roving may be as softly twisted as may be thought necessary; therefore I consider this method of beveling the beam rollers an improvement of much importance, which has not yet been generally adopted in Great Britain.

The fly frames used in Great Britain have the flyers balanced on the top of the spindles, in the same manner as in the common throstle frames; here the three are altogether disconnected. The tops of the flyers run in collars *b b*, fastened to the framing of the machine. The under part of the flyers rest upon *e e* of the wheels *r r*, these are again supported on the wooden beams *s s*. The bobbins *D D*, rest on the rings *o o*, which are connected with the spindles. The bottom rail upon which the spindles rest, ascends and descends by a regular motion, and thereby carries the spindle and bobbin up and down with it. As the bobbin rests upon, and is moved by, the spindle, the speed of the latter varies according to the increasing circumference of the bobbin, whilst the motion of the flyers is equal and uniform, giving a regular twist to the roving.

The double speeder has only one beam, containing three pairs of rollers: the extenser has two, one on each side; therefore the slivers, from leaving the drawing frame until delivered from the extensors, pass through two beams of drawing rollers: now one English fly frame mounted with two beams, will do the work of both speeder and extenser to much better purpose, and at a great saving of room, power, and oil, as well as expense of attendance.

The newest fly frames from Manchester, made by Messrs. Cocker and Higgens, containing their improved spring presser, have already been introduced into this country, and put in operation at Matteawan, in the State of New York; and I have no doubt that as soon as their merits become known, they will be generally adopted, and entirely supersede all the other roving machines mentioned in the preceding pages. Those fly frames made by the above-named machinists, are in every respect superior to any roving machines which I have yet seen either in this country or in Great Britain. They are superior to the double speeders and extensors—so much admired in this country—in various most essential qualities of Cotton Spinning Machinery. First, fly frames are less complex, and, of course, more easily adjusted and kept in order. Second, they condense the process, and thereby save waste and expense for attendance. Third, they save room, power, oil, &c. &c. Fly frames in Great Britain cost only about one-fourth of the price of double speeders in this country. The latter being sold at from 35 to 36 dollars per spindle, whilst the former cost only about as many British Shillings. Fly frames, however, cannot be driven at so high a speed as the others. The revolutions per minute of the spindles in fly frames are from 800 downwards; while those of the speeder and extenser may, with equal safety, be driven at the rate of from 900 to 1000. The speed of the front rollers of the latter are from 150 to 200 revolutions per minute, diameter  $1\frac{1}{4}$  inches.

The double speeder and extenser are almost universally used throughout the whole of the Eastern

district. The eclipse and plate speeders are used chiefly about Paterson in New Jersey, and some other places in the Middle and Southern districts. Mule stretching frames are employed for finishing frames about Rhode Island and Connecticut, particularly for fine spinning, that is, from No. 40 to No. 50. The finest yarn spun in the United States, of which I have been able to obtain any account, is only No. 60, except that which is made for sewing thread, some of which is as fine as No. 110.

Twenty finisher cards, 36 inches broad, supply six drawing frames, containing three heads each; six double speeders, containing eighteen spindles each; and seven extensers, containing eighteen spindles on each side, = 252 spindles in all on the extensers.

Seven extensers, containing 36 spindles each, supply two-hank roving for 4,416 throstle spindles, producing six hanks each per day of No. 18 yarn = 26,496 hanks. Therefore each extenser spindle produces  $105\frac{1}{7}$  hanks of yarn per day; each speeder spindle  $245\frac{1}{3}$  hanks; each drawing frame of three heads 4,416 hanks; each finisher card 13,248 hanks, or  $73\frac{2}{3}$  lbs. of yarn per day.

The preceding may be regarded as the average produce of these machines: some may produce more, but there are many that produce less. It is necessary to mention, however, that the throstle spindles referred to as producing six hanks per day, are what in this country are called the *dead spindles*, known in Great Britain by the name of *Montgomery's Patent Throstle Spindle*, or the *Glasgow Patent Throstle*.

To attend six drawing frames, the front of twenty

finisher cards, and the back of six speeders, will require twelve girls receiving 48 cents each per day = 2/ Sterling—six speeders require three girls at 60 cents per day = 2/6 Sterling—seven extensers require five girls ; four attending three sides each, and one attending two sides, at 60 cents per day = 2/6 Sterling. Girls attending the spinning frames are paid at the rate of 50 cents per day\* = 2/1 Sterling. One girl can attend four sides of 48 spindles = 192 spindles of the above-named thrusters, spinning No. 18, and producing six hanks per spindle per day. In general, the spinning girls, and in some Factories, the speeder and extenser girls, are paid by the quantity of work done. This is ascertained by small clocks mounted at one end of each frame, and moved by the back rollers which properly indicate the revolutions of the back roller, and from these, calculations are made to find the length taken in, according to which a scale is made out, by which each girl is paid a given rate for a given quantity of work.

Turning to the figure on page 64, it will be seen that the spindles are driven by bevel wheels at the bottom, like the fly frames of Great Britain, but the flyers in the speeders and extensers, are driven by spur gears. (*See the figure.*) The wheels  $r\ r$  drive the flyers, and instead of the teeth of these gears being cut right across, they are cut in an angular or slanting direction, and denominated spiral gears. Small gears or pinions of this kind, are cut in a

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\* These rates of wages were furnished to the author by a gentleman in Lowell, who had ample means of ascertaining the different rates of wages paid in the various Factories in that place.

cutting machine, with a very fine pitch, and are extensively used in this country on the drawing rollers of spinning frames, speeders, and extensers. For the drawing rollers, the pitch is from 23 to 32 teeth to the inch. They run perfectly smooth and free, without the least vibration, the whole breadth of the teeth not being in contact at one time; for as the one side comes into contact with its opposite, the other is just going out. The friction of the teeth in the two opposite gears, is therefore not so apparent as in those cut in the common way; for that reason the spiral gears are much better adapted for the drawing rollers of all roving and spinning machines.

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## SPINNING MACHINES.

THROSTLE Spinning Frames are universally used for spinning warps in the American Cotton Factories, with the exception of a very few where a superior quality of fine goods is manufactured, from No. 40 yarn and upwards. The few Factories in which these fine goods are made, use mules for both warp and filling. Some of the recently built Mills at Lowell spin No. 50 yarn, both warp and filling, on throstle frames; but the cloth made from such yarn cannot be compared with that spun by mules.

Mules are generally used for spinning, filling, or weft, about Rhode Island, Connecticut, and the Southern Factories, with the exception of those at

Baltimore, which follow the Lowell style of machinery.

In Lowell, and generally throughout the whole of the Eastern district, throstle spinning frames are used for spinning both warp and filling; and in this district too, the particular kind of spinning frames employed, are almost entirely the *dead spindle*, mentioned at page 67. In the Middle and Southern districts the *live spindle*, or the old common throstle frames are generally used.

The Cap Spinner, known in Great Britain by the appellation of the Danforth Throstle, is used in some Factories in Paterson, New Jersey, and a few others about Rhode Island: but so far as I can learn, it has not been so successful in this country as in Great Britain; indeed, its success in the latter country is greatly owing to the many improvements made upon it since its first introduction.

The Ring Throstle, or, (as it is sometimes denominated) the Ring and Traveller, has been put in operation in various Factories about Rhode Island and other parts; and I am told it has given great satisfaction wherever it has been tried. Having had one under my own charge working along with others of the dead spindle kind, I have no hesitation in saying, that so far as I have been able to test the two together, the ring throstle is greatly superior to the others. It requires much less power, and may be driven at a much higher speed, and at the same time it makes a better quality of yarn.

Mr. Gore's patent throstle spindle has been introduced into this country, and put in operation at Taunton, Massachusetts, and is regarded by compe-

tent judges here as a most important improvement. Having had an opportunity of seeing this throstle in full operation in various parts of Great Britain, I have no hesitation in pronouncing it the best that has yet come under my observation. I found the current opinion of practical men both in Scotland and England strongly in favour of the old common throstle. But Mr. Gore's patent partakes of all the merits of the other, while at the same time it can, with safety, be driven at a much higher speed. Driving machinery at a high speed, however, does not always meet with the most favourable regard of practical men in Great Britain; because in that country where *power* costs so much, whatever tends to exhaust that power, is a matter of some consideration: but in this country, where water power is so extensively employed, it is of much less consequence. Besides, the expense of labour being much greater in this country than in Great Britain, the American manufacturers can only compete successfully with the British, by producing a greater quantity of goods in a given time; hence any machine that admits of being driven at a higher speed, even though it should exhaust the power, if it does not injure the work, will meet with a more favourable reception in this country than in Great Britain. For these reasons alone can I account for the extensive use of the *dead spindle* spinning frame in America; as the same spinning frame was tried in Glasgow under the most favourable circumstances, and never realized the high expectations entertained regarding it upon its first introduction. In fact it may be said to have turned out a total failure in that

country, and yet it has been very successful here. The chief objections to it in Glasgow were its immense weight and consequent exhaustion of power, together with the great quantity of oil it consumed. The same objections would prevail against it here, but for the reasons already specified.

The weight of the dead spindle spinning frame compared with the common throstle, is considered to be as 80 of the former is to 100 of the latter ; that is, one horse power is deemed sufficient to move 100 spindles of the common throstles with the necessary preparation, while the same power is required for 80 of the other.

Both Mr. Gore's patent spindle and the ring throstle obviate, in a great measure, the objections urged against the dead spindle. They require much less power and oil, and may with safety be driven at a higher speed.

In order to ascertain the average speed and produce of the dead spindle spinning frames of this country, I have had access to memoranda, containing an account of them in a number of Factories in various parts of the United States ; and without specifying any particular Factories, it may be stated in general, that the speed of the front rollers of these frames, which are one inch in diameter, will range from 60 to 100 revolutions per minute for all numbers between 12's and 40's ; but some of the fine spinning frames are even below 60. Some Factories in Lowell had the speed of the front roller as high as 110 revolutions per minute for No. 14, but it was afterwards brought down to 100, as being considered more profitable. The average speed of the

flyers according to their diameters, will range from 3,800, to 4,700 revolutions per minute ; and their average produce is from  $4\frac{3}{4}$  to  $6\frac{1}{2}$  hanks per day of  $12\frac{1}{4}$  hours. The ring throstle can produce one-fourth more than the dead spindle. Their relative speeds, as I have had them working, are as 80 of the latter to 100 of the former. Dr. Ure gives the following as the produce and speeds of the English throstle frames.

“ The quantity turned off is about 24 hanks per spindle of 30’s twist in 69 hours.\* \* \* In some Factories, with new throstle-frames, fully 30 hanks\* of 34’s or 36’s may be turned off.

“ In spinning 32’s, the front rollers of the common throstle make 64 revolutions per minute, and the spindles 4,500. For the spinning of lower numbers, the rollers go quicker ; thus, from 28’s to 30’s they make from 68 to 70 revolutions.\* \* \* In Mr. Orrell’s Factory, for 36’s the front rollers make 72 revolutions per minute, and the spindles 4,000.\* \* \* \* \* At Hyde, where excellent throstle-yarn is spun,  $3\frac{1}{2}$  hanks of 36’s are the average daily quantity per spindle, or about 21 hanks in 69 hours.

“ I visited a great Factory at Stockport, where the throstle-spindles revolved 5,000 times in the minute ; and the front rollers 90 times, in spinning 36’s. These machines were constructed by Mr. Gore of

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\* If such is the produce of the common throstle in England, it is more than I was accustomed to witness in Scotland, even with the best constructed machinery. I am not aware of any in that country that have been able to keep up more than 24 hanks per week on any numbers.

Manchester. I was informed that Mr. Axton, of Stockport, had contrived a modification of the throstle-spindle, in consequence of which he could give the front rollers a speed of 80 turns in the minute, and the spindles 7,000 turns, in spinning 24's."

From the above it will be seen, that the common throstle in England is capable of producing nearly as great a quantity of yarn in a given time, as the dead spindle of America: and that Mr. Gore's improved spindle will even exceed the latter. Hence from all I have seen or can learn regarding the different throstles that have been brought into general use, I do consider the ring throstle and Mr. Gore's improved throstle, as greatly superior to any others that have yet been introduced.

The ring throstle, owing to the vibration it gives the yarn, tends to start the fibres, and make the thread more rough and spongy; but Gore's throstle gives the yarn all the wiry smoothness of the common throstle. Each of these will be appreciated by manufacturers according to the particular purposes for which the yarn is to be appropriated.

It is unnecessary here to describe Mr. Gore's improvement on the throstle spindle, as that, it is presumed, is already generally known; but the principle of his patent spindle has been applied to the bobbin and fly frame (at Matteawan, New York,) upon which it has effected a considerable improvement. Its application to the fly frame, however, is said to have been tried in Manchester before it was brought to this country.

Good throstle frames cost about 10/ per spindle in Glasgow and Manchester. In Lowell they cost

from 4 to  $4\frac{1}{2}$  dollars, or about 18/- Sterling per spindle.

The best mules I have seen in this country are made at Providence, Rhode Island. They are altogether upon the plan of the mules made in Scotland. Indeed, judging from the opportunities I have had of examining them at different times, and in various Factories, I consider them equal to the best now made in Glasgow. Their only deficiency is the want of the taking in apparatus for returning the carriage home to the beam-rollers.

The rate at which mule spinners are paid in this country, will average from eight to ten cents per 100 hanks = 4d. to 5d. sterling. When I last visited Newport, Rhode Island, I saw some operative spinners whom I had known in Glasgow: they were then working from sunrise to sunset, that is, from half-past four o'clock in the morning, to half-past seven o'clock in the evening, spinning No. 30 for *seven cents* per 100 hanks =  $3\frac{1}{2}$ d. sterling. This I was informed, was the rate generally paid in that part of the country. But when trade was good, the rate per 100 hanks was raised to eight or nine cents; some fine spinning Mills paid as high as eleven cents for No. 40 power loom warps. This last rate of paying for mule spinning, however, was previous to the late depression of trade. I have since that been told by spinners in Providence, that these same Factories that paid eleven cents, have now, together with all others in that part of the country, reduced their rate of paying about 40 per cent.

The Self-acting Mule, invented by Mr. Smith of

Deanston, has been introduced into America, and put in operation in the State of New York ; but there are several circumstances which operate against its rapid or extensive use in this country. Girls are not employed here as piecers, and lads of sufficient age to attend these mules, are scarce, and charge high wages ; overseers are also highly paid, and there are few mechanics sufficiently acquainted with mules to keep self-actors in repair ; yet, from the well known energy and ability of the talented inventor of these mules, and the advantages derived from their use in Great Britain, as exhibited in the statements which follow, and with which I have been kindly favoured, it is not unlikely but they may yet obtain an extensive adoption in this country.

Cost of Mr. Smith's Mules per spindle when new,	8/
— of adapting the self-acting motion to Hand Mules, per spindle,	3/6
— of Messrs. Sharp, Roberts & Co.'s Mules, per spindle, new,	9/6
— of adapting their self-acting motion to Hand Mules, ....	4/1
— of Mr. Potter's Mule, per spindle, new,	7/6
— of adapting his motion to Hand Mules, .....	3/3
— of Common Hand Mules in Glasgow, per spindle, new,	5/6

From the above it will be seen, that for Mr. Smith's Mules, about £75 of extra capital is required to fit up 600 spindles, self-actors, and about £100 to adapt the motion to hand mules ; perhaps £10 may be added to this last sum for sundry articles that may be required. Keeping this in view, the following will shew the cost of working a pair of self-actors of 600 spindles for two weeks, producing 21 hanks per spindle per week of No. 86 weft.

Wages to Piecers, 25,200 hanks @ 1/9 per 1,000 hks.	£	2	4	1
Extra attendance of Spinning Master and Mechanics, ..	0	5	0	
Interest and charge for tear and wear on £110 extra				
Capital, @ 7½ per cent,.....	0	6	3	
Extra charges, including Power, Oil, and Banding, .....	0	5	0	
Insurance on extra Capital, .....	0	0	8	
Nett charges for two weeks,.....	£	3	1	0
being 2/5.05 per 1,000 hanks.				

The lowest price paid for hand-spinning in Glasgow at present, is  $2/10\frac{3}{4}$  per 1,000 hanks ; this is what is technically called the  $2\frac{3}{4}$ d. per shilling rate.\*

At the termination of a strike in Glasgow, in April 1838, an agreement was made between the operatives and their employers, by which the rate was fixed at  $3/5$  per 1,000 hanks for No. 40's, with a discount of 1 per cent off the gross wages for every 24 spindles which any spinner had under his charge above 600. In consequence of this clause, many of the manufacturers got two wheels coupled together, and gave 1,200 spindles and upwards to each of their spinners. The following small table is intended to shew the annual difference on every 1,000 spindles of each of the three methods,—common, hand-coupled, and self-acting mules ; the produce supposed to be 21 hanks per week, No. 36's west, and the rate allowed for the common mules is the lowest at present paid in Glasgow, viz.  $2/10\frac{3}{4}$  per 1,000 hanks,—that for the coupled mules  $3/5$ , with the discount

\* The above rate refers to an old list of prices, in which No. 100's was paid @ 2/ per lb. but in the progress of the manufacture, the price has gradually fallen to  $5\frac{1}{2}$ d., or  $2\frac{3}{4}$ d. per shilling.

allowed for 1,200 spindles,—and the rate for the self-actors is that found in the preceding table.

	Hand Mules.			Coupled.			Self-acting.		
Price $\text{P} \text{lb.}$ for No. 36's,		1.241			1.096			1.038	
Cost of spinning 30,333 lbs. No. 36's from 1,000 spindles in 12 months,	156	16	11	138	15	6	131	3	10
Gain $\text{P} \text{annum}$ on 1,000 spindles of coupled & self- acting over hand mules,				18	1	5	25	13	1

In the above estimate no allowance is made for the difference of produce. It is likely to be greater from the self-acting, and less, with the yarn somewhat inferior, from the coupled mules.

The following statements have been obligingly furnished by gentlemen in and around Glasgow, all of whom have had extensive acquaintance with self-acting mules ; and having had ample opportunities of judging of their merits, their statements will be valuable to all who are anxious to obtain correct information regarding self-acting mules in Scotland.

The first relates to a Factory having a large number of spindles fitted up with Smith's self-acting motion.

“ Speed of our spindles, for No. 36's warp, 6,400 revol. $\text{P}$ minute.	
..... for No. 18's west, 4,800 .....	
Produce ..... of No. 34's warp, 18½ hanks per week.	
..... of No. 40's do. 17 do. do.	
..... of No. 18's west, 23 do. do.	
..... of No. 34's do. 22 do. do.	
Wages of Piecers,..... for No. 34's to 46's 1/9 per 1000 banks.	
..... for No. 20's 1/11½ do. do.	
..... for No. 18's 2/ do. do.	

"There is considerably more trouble with the self-acting, than with the hand mules, arising from the extra machinery required to perform all the different movements: our spinning master attends upwards of 10,000 spindles, but we find he has rather too much to do."

The next relates to the same description of mules, and contains a comparison of the price paid per lb. for self-acting, and that paid for hand spinning, in the immediate neighbourhood, the rate being  $3\frac{1}{4}$  per 1,000 hanks; but it must be observed that the price noted for self-acting is the nett amount paid for wages, and does not include anything for extra capital, charges, &c. These will amount to 20 per cent on the wages, yet, even taking this into account, the difference is still very considerable.

No. of Yarn.	Self-acting.		Hand Mules.
	Produce, Hanks.	Cost per lb.	Cost per lb.
30	24	.5625	1.125
40	24	.75	1.5
50	19	.7813	2.125
60	17½	1.047	2.75
70	16½	1.313	2.375

"We allow one spinning master for every 8,000 spindles, and our piecing costs about  $1/5$  per 1,000 hanks."

The next statement relates to a work in which several pairs of Mr. Smith's 'self-acting' mules have

been for a considerable time in operation along with hand mules, and the statement shews the actual cost and produce from 1,872 spindles, each, self-acting, and hand mules, during the period represented.

Time taken by Hand Mules to produce	
359,424 hanks, No. 41's, .....	114½ days.
Produce per spindle per week, .....	22 hanks.
Cost of spinning @ 3/1 $\frac{3}{4}$ per 1,000 hanks,.....	£56 10 8
Time taken by Self-actors to produce	
359,424 hanks, No. 41's, .....	96 days.
Produce per spindle per week, .....	24 hanks.
Piecers' wages, 1/9 per 1,000 hanks, .....	£31 9 0
Extra attendance of spinning master & mechanic, 4 4 1	
	35 13 1
* Gain by Self-actors, .....	£20 17 7

The two statements which follow refer to Messrs. Sharp, Roberts & Co's. self-acting mules, and exhibit the produce, &c. of two Mills in which they have been extensively adopted.

1st. " Produce, No. 50's, 19 hks.: cost of piecing, 1/6 $\frac{3}{4}$ 1,000 hks.	
..... No. 60's, 17 $\frac{1}{2}$ do. ....	1/7 do. do.
..... No. 70's, 17 do. ....	1/9 do. do.

" It takes two men two weeks to fit up the headstocks of a pair of mules. A spinning master may attend 10,000 spindles."

\* It must be observed that no allowance has been made in the above statement for extra capital, charges, or insurance. From 20 to 25 per cent should be added for these, which would still leave about £13 in favour of self-actors.

*2d.* “ The speed of our spindles runs from 4,800 to 5,500 revolutions per minute.

“ Produce, No. 20's & 24's, 22 hks : cost of piecing, 1/8 \$1,000 hks.  
..... No 36's 21 do. ..... 1/9 \$1,000 do.

“ One spinning master may attend from 6 to 7,000 spindles. A mechanic is required for the same number ; and the mules are expensive to keep up.”

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I have made particular inquiry regarding the self-acting mules said to be invented by Dr. Brewster, and I find that these were not mules, but rather a species of self-acting common jenny, invented, not by Dr. Brewster, but by a mechanist of the name of Brewster.

The chief peculiarities of Brewster's self-acting jennies, consisted in having the spindles placed in a horizontal position, about 12 or 14 inches off the floor ; and the clasp, together with the creels, containing the rolls or coarse opening, rose and fell in a perpendicular direction. That is, the clasp ascended, while the yarn was being stretched and twisted ; and this completed, the spindles backed off, and wound on the twisted yarn : while winding on, the clasp descended till within a few inches of the spindles, and again commenced another operation, and so on, alternately ascending and descending, whilst the spindle frame was stationary. These jennies were only used in Woollen Factories, but are now entirely abandoned, the same process being now performed by the common stretching mule, similar to those used in cotton spinning.

There is a species of self-acting mules used at Nashua, New Hampshire, which are said to be very

imperfect and complex, and not likely to be adopted by any other manufacturing company, as not being considered equal to the common hand mules.

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## SPOOLING OR WINDING MACHINES.

MANY of the old Factories of Great Britain are exclusively occupied with the necessary machinery for manufacturing cotton yarns, whilst others are entirely occupied with weaving. In this country there are but a very few small Mills, chiefly about Rhode Island, that are employed for spinning only; and a considerable portion of the yarn manufactured in these Factories is used for sewing thread and stocking yarn. All the respectable establishments have both spinning and weaving conducted under the same roof.

In those departments of the cotton manufacture which relate to carding and spinning, I consider this country much behind Great Britain, especially in the carding. But in those which relate to weaving by power, the Americans have in every respect equalled, and in some things surpassed, anything I have yet seen, either in Glasgow or Manchester. I refer to common power-loom weaving. In fancy weaving, either by power or hand, this country, so far as I am informed, has not yet made a beginning.

Amongst that series of machines which belongs to power-loom weaving, the first in order is the Spooling Machine, by which the yarn is wound off copes,

or small bobbins, on to larger ones, called spools, for the warping machine.

Plate V. represents the spooling machine used in this country, which I consider much superior to the common winding machine of Great Britain. It is certainly much more simple, and can be attended by girls from eleven to fourteen years of age, who, upon the American spooler, are capable of doing as much work as a woman of thirty, upon the British.

*Fig. 1st* represents a common cylindrical shaft containing sixteen drums: A A A A are four bobbins, or spools, laid on two of the drums, and driven by friction: B B represent cast iron arches placed between each pair of drums, which serve to keep the spools in their places (*see a a, Fig. 2d.*); each spool has small projecting ends, which serve instead of skewers (*see Fig. 1st.*): c c are the bobbins from the spinning frame: n n are round pieces of iron covered with cloth, lying on the moveable rails o o. Pieces of cloth are also fastened on the rails beneath the cleaners n n, so that the thread passes through between two plies of cloth, which partly smooth down the fibres, and clean it from any loose specks that may adhere to it: e e are guide pins fastened on the rail o o. The pulley E, driven by a band from the cylinder shaft, is connected with a heart motion, which moves the rails o o alternately in a horizontal direction the full length of the spools, and by means of the guide pins e e, causes the yarn to wind on equally from end to end. Each drum is covered with cloth or leather, and requires to be perfectly true, as otherwise it would give a vibratory motion to the spools while the yarn is winding on.

The whole machine is extremely light, simple, easily attended and kept in order. One of twenty drums may be attended by two girls of twelve years of age, and is capable of winding 3,000 hanks per day of  $12\frac{1}{4}$  hours.

Instead of winding the yarn off the small bobbins on to others of a larger size, it is common in a number of Factories to take the small bobbins direct from the spinning frame to the warping machine, which is mounted with a small rack or creel suited to the size of the bobbins. This creel, rack, or bobbin frame, is attached to the back of the warping machine, and lies in a horizontal position, but is hollowed in the centre like a cradle; hence it is denominated the cradle warper. The girl who attends this machine stands with her face towards the back of the warper, having the bobbin frame intervening; she thereby has all the bobbins within her reach, so that whenever she perceives one about empty, she is ready to remove it, replace it with a full one, and tie the two ends of the thread, without stopping the machine. And owing to the number of bobbins in the frame, and the small quantity of yarn contained on each, they are constantly emptying, while the attendant is constantly supplying their places with full ones: but in order to prevent them from running out entirely, she requires to take out a considerable number before the yarn is completely wound off. The yarn, therefore, which is left on the bobbins, if not wound off at some other machine, is liable to be made into waste. Hence the cradle warper has not been generally adopted, as it has been found that the loss from the quantity of waste made

by it, is greater than the expense required for spooling, or winding the yarn from small bobbins on to others of a larger size, suited to the common bobbin frame of a warping machine.

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#### WARPING MACHINE.

THE next Machine in the series, is the Warping Machine: and as all those I have seen in this country are furnished with a stop-motion, by means of which the machine is instantly stopped when a thread breaks, I have in Plate VI. given two views of this warper, chiefly for the purpose of illustrating this rather curious contrivance, the origin of which is ascribed to the inventive genius of Mr. Perkins, inventor of the celebrated steam gun.

*Fig. 2d, Plate VI.* is a side view of the warper : A A, *figs. 1st and 2d*, the framing of the machine, which, being made of wood, gives it a heavy appearance in the engraving: B, *figs. 2d and 4th*, are the threads of yarn proceeding from the bobbin frame to the iron plate c, where each thread is separated ; the plate c being perforated with small holes corresponding to the number of threads to be wound on the beam. Passing the plate c, where all the threads are brought into one horizontal plane, they thence pass over the rods a a ; from these through the guide reed p, and on to the beam H, which is represented as containing only the first round of yarn. The belt pulleys K are on the same shaft with the wheel G, which drives E ; on the same

axis with E, is the drum D, which drives the yarn beam H. The iron axis of the yarn beam rests in two slots of the framing at X, and is pressed down upon the drum D, by the stirrup *m m*, which is also weighted down by the cross lever F. From the top of the stirrup *m*, an arm J extends to the guide reed *p*, so that as the yarn fills on the beam H, it gradually rises, and the arm J presses up the guide reed with the same gradual motion, so as to keep it always in a proper position in relation to the increasing diameter of the yarn beam: L, *fig. 2d*, is a strap attached to the weight M, and which winds round a small shaft, on the end of which the ratchet wheel N is fastened. When the yarn beam is sufficiently full, the strap L is wound up by means of a wrench attached to the ratchet wheel, which thereby lifts the weight M, the lever F, and the stirrup *m*, until the hook on the axis of the yarn beam at X, is so far relieved as to be pressed back: the full beam is then removed, and an empty one put in its place—the stirrup is brought forward till the hook is right above the axis of the beam—the catch of the ratchet wheel is lifted—the strap unwound—and the machine is then ready to warp another beam.

From the preceding description, it will be seen that this warping machine in its general operations, differs very little from those used in Great Britain. In every respect it is equally as simple, efficient, and easily attended; besides having the advantage of the stop-motion, which is now to be described.

As the yarn from the bobbin frame enters the plate c, it passes over the rods *a a*; but between these rods, there is a drop-wire suspended upon

each thread : these drop-wires are pieces of flattened steel wires, about four inches long, from  $\frac{1}{8}$  to  $\frac{5}{16}$  broad, and  $\frac{1}{16}$  of an inch thick. (*See fig. 5th.*) Some of these which I weighed, varied from 4 grains 4 dwts. to 4 grains 10 dwts. They are hooked at the top, and suspended by their own weight on each thread. (*See o o o, front view, fig. 1st, and o, fig. 4th.*) When the machine is in operation, the drop-wires are borne up by the tension of the yarn, but as soon as any one thread breaks, it slackens, and, of course, the wire drops down till the point of the hook at *d*, *fig. 5th*, rests on the plate *n n*, *fig. 4th*; and it is this dropping down of the wire that stops the machine. The shaft *y y* extending across the machine, has an eccentric at *P*, *figs. 1st and 4th*, which works into the fork of the lever *R R*. On the top of the lever *R R*, there is a small tumbler *s t s* attached to the steel plate *e*, *figs. 1st and 4th*. The lever *R R* turns upon a journal at *T*, *figs. 2d and 4th*; and in consequence of the eccentric *P* working into the fork, the top of the lever, and with it the tumbler *s t s*, and the plate *e*, are made to oscillate right under the drop-wires; so when a thread breaks, the wire drops down, and retards the oscillating motion of the plate *e*, which immediately depresses either end of the plate *s s* of the tumbler, which again presses down the lever *u v* at *u*, and raises the other extremity at *v*. By lifting the lever at *v*, the rod *r r*, being then disengaged, is operated upon by the spiral spring *f*, *fig. 1st*, which causes it to shift so far as to act upon the upright rod *k*, and turn it round as far as to make the belt lever at *Q*, shift the belt from the fast on to

the loose pulley. And as these various parts are fitted so as to operate all at once, the whole machine upon the breaking of one thread is instantly stopped.

When the broken threads are all tied, and the machine ready to be put in motion, the girl attending, lays hold of the rail *z z*, *fig. 1st*, and pulls it forward: *x x* are straps of leather fastened to the wooden frame *W W*, containing the drop wires; therefore, by drawing down the rail *z z*, the shaft *h h* turns round, and causes the straps *x x*, to raise the frame *W W* so far as to lift all the drop-wires above the top of the plate *e*, which keep their places by the tension of the yarn, as soon as the machine gets into full operation. In lifting the drop wire frame *W W*, it also draws up the point *q*, of the small lever *q l*, *figs. 2d and 4th*, which causes the other extremity *l*, to operate upon an arm of the upright rod *k*, and turn it round as far as to let the belt lever at *Q* shift the driving belt from the loose, on to the fast pulley: at the same time another arm *Y*, of the upright rod *k*, *fig. 2d*, also operates upon the rod *r r* at *b*, *fig. 1st*, and shifts it to the right hand, untill the point *v* of the lever *u v*, drops into the square groove seen in *fig. 1st*: the lever or catch *v*, is kept in the groove of the rod *r r*, by the small spiral spring *i*. Thus, by pulling forward the rail *z z*, the drop-wires are lifted, and the whole machine is instantly put in operation; and, by lifting the catch *v*, the rod *r r* being operated upon by the spiral spring *f*, it is as instantly stopped.

*Fig. 3d* is a front view of the guide reed *p*, seen in *fig. 2d*, for directing the yarn on to the beam *H*. It consists of a piece of sheet iron cut into a number

of slits, corresponding to the number of threads to be warped on the beam. By examining the figure, it will be seen that the slits are so contrived, that a lease may be formed on each beam if necessary.

The views of the warping machine given in Plate VI, are chiefly designed to exemplify its general movements, but more especially those of the self-acting stop-motion, which, by carefully examining the figures, and attending to the descriptions given, may be easily understood. *Fig. 4th* is also represented in its proper place in *fig. 2d*; the former being drawn to a larger scale, merely for the purpose of giving a more accurate representation of its operations.

In looking at the representations given of this machine, those unacquainted with it might be apt to suppose, from the number of levers, springs, &c. depending on each other, that it would work inaccurately, and be difficult to keep in order. This, however, is not the case. Although acquainted with the most improved warping machines made in Glasgow up to the year 1836, and having had opportunities of observing the operations of the newest made in Manchester, particularly in Mr. Orrell's Factory at Stockport, and in other places; yet I have not seen any that made more perfect work, or required less attention, than those just described. The warping machines used in Great Britain require the utmost attention on the part of the attendant to notice instantly when a thread breaks; as should her eye be diverted from her work but one moment, the end of a broken thread might wind round the beam so far, as to require five minutes or

more to find it, and put the machine again in motion. But this is not the case with those used in this country; for while the machine is in operation, he attendant is frequently behind the bobbin frame, taking out empty spools, and supplying their places with full ones; nor could the cradle warpers of this country be used, except by being furnished with a self-acting stop-motion. This motion is, therefore, eminently entitled to the appellation of an important labour-saving improvement.

I omitted to state in its proper place, that the drum D, *fig. 2d*, on which the yarn beam rests, and by which it is moved, is exactly one yard in circumference, and upon the one end of its axis, there is a screw working into small geared wheels connected with an index, which indicates the revolutions of the drum during the warping of each beam, from which the length of yarn on each beam is ascertained, and the attendant is paid accordingly.

Upon an average of weeks, I find a smart girl can warp 13 beams per week of No. 12's, each beam containing 300 threads of 3,000 yards in length, for which she is paid about 27 cents per beam, being 3 dollars 51 cents, =  $14\frac{1}{4}$  for 13 beams, or, per week. Another ordinary hand can average 9 beams per week of No. 18's, each containing 300 threads of 5,000 yards in length, and for which she is paid 33 cents per beam, being two dollars 97 cents, =  $12\frac{1}{4}$  for 9 beams, or, per week. Besides the length of yarn on each beam being ascertained, they are also weighed to ascertain the weight of each, a correct account of which is regularly kept.

## DRESSING MACHINES.

THE Dressing Machines used in this country, are made upon an entirely different construction from any I have seen either in England or Scotland. They are much more simple, more easily attended and kept in order; besides requiring less power and oil. And I believe one could be made in Great Britain for one-half the cost of those now made in Manchester and Glasgow.

Plate VII. represents a side view of the dressing machines used at Lowell, and generally throughout the Eastern district. A A is the centre frame, supporting the centre beam  $\alpha$ , containing the dressed yarn. The wheel E on the centre beam, is fastened with a set screw, so as to be easily taken off when a full beam is to be removed, and put on the empty beam which is to replace it. B B B to the right and left are the section frames, all made of wood, containing the section beams H H H H. The ends of the section beams are of cast iron, with a square groove for receiving a friction strap, and a weight represented at v v v v. The sizing rollers are represented at y y y y. The yarn as it leaves the section beams, passes through a raddle or ravel, made of small pieces of hard wood, and represented at u u u u,—from that, through between the sizing rollers,—again, through a brass wire reed at o o o o,—through a copperplate supported by b b,—through another brass wire reed at d d,—and under the measuring rollers N N,—at which place the yarn from the four beams on each section are, for the

first time, brought all into one horizontal plane. From the rollers N N, the two sections of dressed yarn pass up through heddles at *k*, called the lease harness; from that it is wound on to the centre beam *a*, at the top. The lease harness may be shifted to either side of the frame by means of a screw at *k*, and only one section of the dressed yarn goes through heddle eyes in the lease harness; so that when a full beam is to be removed, a lease rod is introduced between the two sections of yarn above the harness, then, by drawing the harness to one side, another lease is formed, into which a rod is introduced.

The different operations of the machine are effected in the following manner. F are the fast and loose belt pulleys, driven by a belt from the room below; n n are two cones, that to the right being driven from the one to the left, by the cross belt R. On the axis of the cone to the right hand, there is a small bevel wheel working into another on the bottom of the upright shaft *r r*: on the top of the upright shaft, there is a small bevel wheel working into the wheel *c*, and on the axis of the wheel *c*, there is a small spur gear, not seen in the engraving, working into the wheel E, on the centre beam *a*. Motion being thus given to the cone on the left hand (by the belt pulley F which is fastened on the same shaft,) it is next communicated by the belt R to that on the right, and from it to the beam on the top, containing the dressed yarn; hence the speed of the centre beam *a*, on the top of the centre frame, may be increased or decreased, by shifting the belt R, on the cones n n.

The brush motion is next to be considered : D D D are the brush racks, or brush frames ; they are not fastened to the section beam frames B B B, but are fitted so as to move up and down, short spears z z being fixed to the top and bottom of each side of the brush frames, which slide into the eyes of studs, and serve to keep them in their proper position, as well as to let them move freely up and down : s s s are small blocks of cast iron, which are fitted to slide freely on the polished steel rods h h h : the dotted lines represent straps or belts passing over small pulleys on each side, and descending down to the large wooden pulleys G G, to the surface of which the belts are fastened : the blocks s s s are fastened to the belts by a small nut and screw on the under side, whilst the brushes rest on the blocks above. The feathers represented on the blocks at s s s, fit into slits in the ends of the brushes. W W represent two beams of wood, (one at each side of the machine,) about four inches broad, and three inches thick, called sweeps ; these are supported in the centre at f, and at the end towards the left hand, they are attached to the lever P P, the under point of which supports the whole brush frame ; the other end of the sweeps being attached to the block i, towards the right hand : the block i is a projection from a shaft, extending across the machine at each section, the axis of which is seen at x, and the pulleys G G are fastened on each end of this shaft. By carefully examining the engraving of the various parts of the machine, the reciprocating motion of the brushes, together with the up and down motion of the brush frames, will

now be easily understood. The lever J is connected with a sliding crank on the axis of the cone n, towards the left hand ; consequently, the revolving of the crank moves the sweeps alternately, from section to section; and the end of the sweeps to the right hand, being attached to the block i by a strap of belt leather, the alternate motion of the sweeps moves the shaft x, and with it the pulleys G G, about one-fourth of a revolution each way : this reciprocating motion of the pulleys, draws each end of the straps represented by the dotted lines, and thereby produces the necessary reciprocating movements of the brushes upon the yarn ; while, at the same time, the other end of the sweeps towards the left hand, by means of the lever P P, raises the brush frame, and with it the brushes, up and down at every alternate stroke. Thus, when the brushes are at h h h h, the frame is down, and they are then in a proper position for moving along the surface of the yarn, (which has just been coated with size, in passing through between the sizing rollers,) and having made one full stroke, they are then at the opposite side of the frame, which is immediately raised by the lever P P, connected with the sweeps; and in raising the frame, the brushes are lifted out of the yarn, until they return to their former position at h h h h. The whole movements of the machine commence at the cone n, towards the left hand. From it, motion is communicated by the belt R, to the opposite cone, and from it, to the centre beam a at the top : and from it (the cone n), motion is also communicated by the sliding crank, and the connecting lever J, to the sweeps W W, of which

there are two, and the one end of each moves the brushes alternately from side to side, whilst the other end produces the up and down motion of the brush frame. The whole machine is extremely simple, and all its different movements so contrived, that they can easily be adjusted so as to operate with the most perfect accuracy.

L L represent the fanners enclosed in wooden boxes, open only at the centres for admitting a current of air, and at the mouths Q Q, for throwing it out: by this method of confining the air, it rushes out with much greater force, and the mouths Q Q are made so as to direct it right up amongst the dressed yarn. The fanners here represented have four wings each, but some have only two or three: that to the left hand, is driven by a belt from the room below, and from it, a cross belt communicates motion to the one on the right. X is a hot air pipe, with a branch extending up to the hot air box M, placed between the two rollers N N. The cover of this box extends till within one half-inch of each side, which leaves a small opening for the escape of air, which issues out at each side upon the yarn, and being entirely hot air, it has a peculiar effect in absorbing any remaining moisture upon the yarn, before it is wound on to the centre beam  $\alpha$ , on the top. Instead of the hot air box M, some dressing frames have a centre fanner, similar to those used about Manchester.

The sizing rollers y y y y, are generally made of soap stone, with an iron axis; the under roller only is covered with cloth: one of these rollers, when finished, costs about eight dollars = £1 . 13s . 4d.

The two sections of these dressing machines may be extended out as far as may be thought necessary. In order to diminish the size of the plate, the distance from the centre of the section beams to the centre of the frame, is represented as only  $9\frac{1}{2}$  feet; some, however, extend to 17 or 18 feet. As the greater the distance from the sizing rollers to the centre beam containing the dressed yarn, more time will be gained for drying; but when the section beams are stretched out too far, the yarn is more liable to break with the drag of the centre beam.

On one end of the axis of the measuring rollers N N, there is a screw or worm working into gears, connected with an index which points out the number of yards of dressed yarn on the centre beam; every 33 yards is marked with paint, which allows 30 yards of cloth to each piece, the 3 yards, (equal to 10 per cent.) being allowed for shrinkage in the weaving, &c.

The measuring rollers, in general, are common wooden cylinders, about eight inches in diameter; some are revolving steam cylinders, which, when properly packed at the journals so as to prevent the steam from escaping, has the best effect of anything that has yet been tried for drying the yarn speedily.

It is impossible to give even the average produce of these machines; indeed, in all my experience, I have never known anything so variable as the produce of the dressing machines of this country. In some Factories, their average produce will be about 14 pieces per day to suit a 9<sup>00</sup> reed; yarn, Nos. 14's to 18's. In other Factories, on the same kind of work, these machines will dress 20, in others

30, 40, 50, and 60 pieces per day. Some of those fitted up with revolving steam cylinders, are said to produce even 70 pieces on the same kind of work, viz. coarse 9<sup>00</sup>, yarn No. 14's, and each piece is invariably intended to make 30 yards of cloth. One great cause of this difference in the quantity produced from the dressing machines, arises from the different temperatures in the apartments where they are in operation, as well as from the mode of applying the heat to the dressed yarn. In some Factories the dressing machines are in the same room with the looms, where the temperature seldom exceeds 75°. Those mounted with steam cylinders,\* in place of wooden measuring rollers, generally produce the greatest quantity of work; next to these, are those with the hot air pipes; and next to the latter, are those with three fanners, that is, one at each side, and one in the centre. Those with only two fanners, produce the least quantity of work.

The prices paid for dressing, are as variable as the produce of the machines. Some Factories pay as low as 1½ cents per piece, whilst others pay as high as 4½ cents = 2½d. sterling, for the same kind of work. In fact, the dressing, as well as some other kinds of work, are paid more or less, according to the quantity the machines are able to produce. The great object with all manufacturers in this country, is to pay their help just such wages as

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\* The steam cylinders for measuring rollers were invented by Samuel Batchelder, Esq., Agent of the York Factories at Saco, State of Maine, for which he obtained a patent in 1835.

will be a sufficient inducement for them to remain at the work. Hence the greater the quantity of work produced, the higher the profits, because paid at a lower rate of wages.

The size used for dressing, is generally made of potato starch for all coarse work ; and of flour, for the finer goods, or such as are intended for printing. The mode of preparing the starch for size requires particular attention ; and although different places may have different methods, the two following have been found to suit the purpose remarkably well.

First,—*Method of making Size from Potato Starch for coarse Goods.*

2½ Gallons of yeast, and 2 quarts of vinegar, to be well mixed with about 9 gallons of water, which has been previously heated to 120°, or as hot as the hand will bear to work in it. To these are added 125 lbs. of potato starch. The whole is then allowed to stand in a warm place about 10 or 12 days, or until it is perfectly fermented, then 3½ lbs. of common clean tallow is dissolved in 75 gallons of water, heated to 160°, to which are added 75 lbs. of the fermented starch. The whole is well stirred, until all the ingredients are perfectly incorporated. The size is then to be used immediately before, or after it is perfectly cooled down. To the above, some add about 2½ lbs. of the sulphate of copper, to prevent mould.

The above makes a very superior size. It is smooth, clean, and entirely free from any offensive smell : and although about the same price as flour, it is found to answer the purpose much better for

coarse goods ; very little of it adheres to the yarn, yet quite enough to make it weave well.

Second,—*Method of making Size from Flour for the finer Goods.*

300 lbs. of flour mixed in 45 gallons of water, and allowed to stand for four or five days at blood-heat, until it is perfectly fermented ; this is called yeast. To the above are added about 140 gallons of water heated to 180°. The whole is then boiled by steam from 30 to 45 minutes ; at first it boils thick, but by continued boiling becomes thin in the middle, when it is considered done ; after which it should stand over one week, and be reduced with cold water when used.

*The following mode of making Size from Flour, is practised in Glasgow for various kinds of Goods.*

One barrel of flour is soaked in water, which had been previously heated a little over 120°, and allowed to stand in this state about a week, or until it ferment thoroughly. It is then mixed with about 110 gallons of water in a copper boiler, with a cast iron casing; and by introducing steam into the boiler, as well as into the vacant space between the casing and the boiler, it is gradually heated until it boil ; after which the steam may be admitted at any pressure, and the boiling process continued about an hour ; during which an agitator, driven by the engine, moves round with a slow motion, until all the concretions or lumps are completely dissolved, when a wooden roller being dipt into it, if the small portion which adheres to the roller has a thick,

smooth, glutinous appearance, it is then ready to be emptied out into narrow deep vessels to cool, in which it is allowed to stand for three or four days before using it.

It now only remains to be noticed, that one of these dressing machines when complete, costs in this country 400 dollars = £83 . 6s. 8d, and upwards. And throughout all the Eastern manufacturing district, girls are employed to attend them. Men are employed as dressers about Rhode Island and some other places; but so far as I am informed, there are none in this country make so high wages, as the same class of workmen generally average about Glasgow, (Scotland.)

Besides the kind of dressing frame just described, there is another made at Providence, Rhode Island, and generally used throughout that part of the country, known by the name of Pitcher and Gay's dressing frame. The principal difference between it and the one already described, is, that the former has four pairs of sizing rollers on each section, while the latter has only two; that is, the yarn from the two upper beams passes through between one pair of sizing rollers, and that from the two under beams through another pair. By this and some other contrivances, it appears somewhat more simplified than the other, and, I believe, will be more generally preferred by workmen, as being more convenient and easy to attend. But I have not been able to obtain a drawing of this machine, and without it, a description would be unintelligible to those unacquainted with it.

There is one peculiarity of the American dressing

frames, viz. their requiring but little oil, so that the machines, and all about them, are at all times perfectly clean. The girls who attend them, have no appearance of being even in the vicinity of anything that could soil their clothes. This is not the case with those used in Glasgow, for there no class of workers employed about a Cotton Mill, seem to have dirtier work than those who attend the dressing machines. In some of the new Factories of this country, the floor under the dressing machine is painted a high cream colour, which by a slight washing over once in two weeks, has always a fresh cleanly appearance, as not a drop of oil is to be seen all around it.

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## WEAVING BY POWER.

It has already been stated, that, with respect to common power loom weaving, the Americans have attained to as much perfection as the manufacturers of either Glasgow or Manchester; and some of the machines employed in that department, I consider superior to any of the kind I have seen in any part of Great Britain. As regards the looms now generally used, viz. the crank loom, they are in every respect equal to any made by the best machinists either in Manchester or Glasgow. Those at least which I have had an opportunity of seeing, are in every respect equal, either as a smooth, steady, working machine, or as regards the quantity and quality of cloth produced. I do not say that all the looms used in this

country are as good as those referred to in Great Britain ; but the principle upon which the newest crank looms are constructed, is the same in both countries ; the only difference lies in some of the minor modifications, which do not affect the general merits of the machine.

All the looms I have seen in this country are mounted with a letting-off motion as it is called in Britain ; and with a very few exceptions, they have all self-acting temples. After witnessing the simplicity and efficiency of these contrivances, I am only surprised they have not yet been more generally adopted in Great Britain. The self-acting temples, besides saving a great deal of labour on the part of the attendant, make a much superior, and more uniform selvage, whilst the letting-off motion equalises the number of picks in the cloth, by giving off from the warp beam, exactly as the cloth beam takes up.

It is unnecessary to describe either of these improvements, as it is presumed they are already sufficiently known in Great Britain. When in Manchester in April 1836, I met with Mr. Amos Stone from Rhode Island, who was then introducing his power loom for weaving silk, which contained the self-acting temples and letting-off motion, upon a much improved principle, for which he had taken, or was about to take out, a patent: and since that time, they have been partially adopted in various parts of Great Britain. In this country there is some variety in the form or plan of these contrivances ; yet I have not seen any superior to those of Mr. Stone. But there is another little improvement which has been added to some of the looms about Lowell, that

I do not recollect having seen on Mr. Stone's loom, viz. a self-acting apparatus for shifting the pace weight gradually towards the extremity of the lever, as the cloth beam gradually increases in diameter, by the continued winding on of the cloth.

The ratchet wheel, which moves forward the cloth beam, is itself moved by clicks attached to a perpendicular lever at the side of the loom, which (lever) is operated upon by a stud fastened in the sword of the lathe; and on a horizontal arm of the lever, there is a weight suspended, denominated the *pace weight*. Now every practical man knows, that this weight acts with more power when the cloth first begins to wind on an empty beam ; and as the beam gradually fills with successive layers of cloth, the effect of the weight gradually diminishes. The improvement here referred to, is a simple contrivance, by which the weight is shifted progressively towards the extremity of the horizontal arm of the lever, so as to keep the cloth always at a uniform degree of tension, which, together with the other contrivances, make a perfect uniformity in its quality.

In all the power looms I have seen in this country, the shuttles are propelled in the same way as those used in Scotland, with this difference, that instead of shuttle cords made of coarse cotton yarn or roving, strips of leather are used, which have been tanned and prepared for the purpose. These are called picker-strings, and are made to pass up through a slit right in the bottom of the shuttle box of the lathe, and fastened with nails to the under part of the shuttle drivers, which are made of Buffalo hides. The picker-stick, as it is technically de-

nominated, is also fastened to a cross bar of cast iron, which connects the under ends of the two swords of the lathe, with which it likewise reciprocates, so that in every position of the lathe, the picker-stick is always perpendicular to it ; and the treadles, by which the shuttle is propelled, are pressed upwards.

In order to ascertain how long one of these leather picker-strings might last, I have kept account of the number of sides of picker-string leather used during one year, in a weaving room containing upwards of 100 looms, together with the average number of picker-strings cut out of each side; and according to this, I find that each string upon an average, will last between eight and nine months ; each side will make between 80 and 90 strings. Picker leather costs about 50 dollars per dozen sides in Boston.

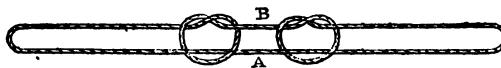
The heddles, or, as they are commonly called in this country, the harnesses, are generally made of cotton yarn : each Factory makes to suit themselves ; but the yarn must always be of a good quality, and generally spun from double roving. Three plies of yarn No. 8's make very good heddle twine for weaving heavy goods, from yarn sizing No. 24, and downwards. Before using the harnesses, they receive two coats of varnish made of the following ingredients :—

1 Gallon Linseed Oil,	$\frac{1}{2}$ Lib. Umber,
1 Lib. Lithorage,	$\frac{1}{2}$ .... Gum Shalac,
1 .... Red Lead,	$\frac{1}{4}$ .... Sugar of Lead.

All these, except the shalac, are first well boiled over a moderate fire, until the strength is out of the lead ; the shalac is then added, but only a little at a time, while the whole is still boiling, and it re-

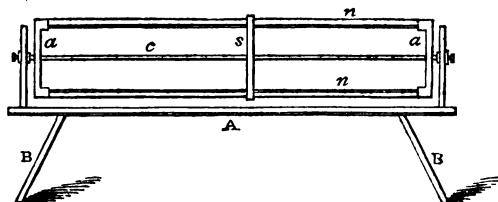
quires to be well stirred all the time. When the shalac is entirely dissolved, the whole is then cooled down to blood heat, then a sufficient quantity of the spirit of turpentine is added, to make it fit for use. Such articles as require it, are to be pulverised. Before putting on the varnish, the harnesses ought to be brushed down with paste or size from the dressing machine: and after the varnish is thoroughly dry and hard, they ought to be brushed down with tallow, to smooth them well before they are put to use. Harnesses properly made in this manner, and perfectly dry before they are used, will generally last over one year.

A patent has been taken out in this country for a peculiar method of forming the eyes on heddles, which consists only of a double knot, one on each side of the eye. (*See the annexed figure.*)



The one side A, is perfectly straight, whilst two single knots are formed on the side B, each of which encloses A, and when drawn tight, the heddle-eye is formed between the two knots, so that in the up and down motion of the harnesses, the warp threads are pressed against the knots, which being hard tied, are not so likely to cut the eye, as if they pressed against a single loop of the heddles.

These patent heddles are made or knit upon a revolving frame represented in the annexed figure.



The above figure represents what is denominated a harness knitting frame: *A* is a plain top of a common form, or stool, supported on the legs *B B*. The centre rod *c* is oval shaped, and made of polished steel or iron: *a a* are the two ends of the knitting frame fastened on the centre rod *c*, and as this rod revolves, the two ends revolve with it: *n n* are the two shafts of the heddles or harness, which fit into slits of the revolving end of the frame *a a*, and are fastened by set screws: *s* is a moveable binder fastened by screws to each shaft, intended merely to prevent them from twisting or bending, and can be moved from side to side, or taken off at pleasure. The eyes of the heddles are formed on the centre rod, at each side of which the knot is tied; the under shaft is then turned up, and the loop formed by the cord; then the other shaft is turned round, another loop formed, and then again the two knots, &c. &c.

One smart girl will knit harnesses on the above frame, to the amount of 120 beers (porters) per day of  $12\frac{1}{2}$  hours, for which she is paid at the rate of one half cent, equal to one farthing per beer.

The general speed of the looms will range about 120 pecks per minute. And I have just now before

me the produce of a room containing 48 looms, weaving jeans, three leaf'd tweel, 38 inches broad, and containing 82 warp threads to the inch, or 3,120 in the whole breadth, 56 to 60 pecks per inch. And for the last four weeks, I find the average produce has been 51 pieces per day, being three over one piece to each loom, or nearly 32 yards daily; the length of each piece being 30 yards. For this, the girls are paid at the rate of 27 cents for the piece, equal to  $1/1\frac{1}{2}$  sterling for weaving 30 yards. A smart girl upon this kind of work will, upon an average, weave 14 pieces per week on one pair of looms, for which she will be paid 3 dollars 78 cents equal to  $15/9$  sterling, the hours of labour being  $12\frac{1}{4}$  daily, or about  $73\frac{1}{2}$  hours per week.

Sometimes one girl attends three looms; but this is seldom allowed, as very few are capable of attending three looms with advantage. It is, therefore, only resorted to in cases of necessity, when the hands are scarce, as it is better to give three looms to the best weavers, than let them stand unemployed.

The shuttles generally used are made of apple-tree, which is very abundant in this country, and suits the purpose remarkably well, being a fine light wood. They cost about five dollars per dozen =  $20/10$  sterling. There is another kind of wood sometimes used, called persimmon, which is much superior to the apple-tree, being nearly equal to box-wood. It is dearer, however, than the apple-tree, but of much finer quality. It grows principally in Maryland, and some other of the Southern States.

The shuttle drivers, as already stated, are made of Buffalo hides, and cost about eight dollars per gross = £1 . 13s. 4d. sterling.

Dr. Ure gives the following as the results of experiments which had been tried to ascertain the necessary power required to move certain machinery employed in the cotton manufacture.

	Mule Spindles with preparation.	Self-acting Mules with preparation.	Throstle Spindles with preparation.	Power-looms with dressing.	Power-looms without dressing.	Dressing Machine.
<b>One horse power drives in the following Mills :—</b>						
Mr. Orrell's Mill, spinning No. 36's, .....	500	300	180	10		
Peil & Williams' Mill, .....				6		
Factory of J. A. Beaver, .....					15	
Clark & Son's Mill, .....					11	1
Average of the above, .....	500	300	180	8	13	1

The following are the results of experiments made at Lowell, in the State of Massachusetts.

	Throstle Spindles with preparation.	Power-looms with dressing.	Power-looms without dressing.	Dressing Machines,	Throstle Spindles without preparation.
<b>One horse power moved as under :—</b>					
Spinning No. 14's, and producing 7 hanks per spindle per day, ....	77*	8.5	12	1.6	105
Spinning No. 40's, and producing 6 hanks per spindle per day, ....	127		12	3.8	{ 160 warp. 188 weft.

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\* The throstle frames used at Lowell are the dead spindle, which are supposed to require at least one-fourth more power than the live spindle.

The preceding details embrace all that is deemed necessary regarding the various machines employed in the cotton manufacture of this country. I have endeavoured to describe each machine in its order, and to point out whatever has appeared worthy of notice, or wherein they differed from those which I was accustomed to in Scotland. Their general produce, and cost of attendance, have been stated; so that any person acquainted with the business in Great Britain may be able to compare those of the one country with those of the other. There may be many things omitted which ought to have been noticed; yet I am not aware of having stated anything that, upon examination, will be found incorrect.

The number of machines taken from America, for which patents have been obtained in Great Britain, have led many to suppose that the Americans must have attained to considerable perfection in labour-saving machinery. This, however, is not the case; nor do I think that, in this respect, they are at all equal to the British: and, indeed, most of those machines that have been taken from this country, are in a much higher state of perfection in Britain, than any of the same kind I have seen here.

A great proportion of the machinery about this part of the country, is fitted up as if never to be altered. The machine makers seem to proceed upon the supposition that their machinery is already perfect. The machines are calculated for one kind of goods, and only one system of working. Hence, in making alterations in the adjustment of any machine, so as to introduce a different system of working, or to suit a different quality of goods, it is frequently

necessary to make some new patterns, in order to accomplish the alterations required. Now the machinery used in Great Britain is, in this respect, greatly superior to the American. There, every machine is so constructed, that all its parts can be adjusted with the greatest accuracy, to suit the various qualities of cotton, or whatever kind of goods may be wanted: and, consequently, the manufacturers can easily arrange and alter their machinery, so as to make just such goods as will for the time being suit the market. But here they can make only one kind of goods, whether they suit the present demand or not, as they have not the same facilities for changing the style of their goods, so as to take advantage of the variations in the markets.

The framing of a great part of the machinery in this country is made of wood painted green; indeed, this is the prevailing colour for painting the wooden part of the machinery, such as that of cards, speeders, spinning frames, spooling, warping, and dressing machines, looms, &c. There are also a great many machines made with cast iron framing. Of these, some very superior machinery is made at Pawtucket and Providence, State of Rhode Island; and at Matteawan, in the State of New York. At this latter place, the drawing rollers for throstles and mules are covered with fine velvet cork-wood, for which a patent has been taken out, and are said to suit the purpose much better than those covered in the ordinary way with cloth and leather.

In giving the preceding details of the various machines employed in the cotton manufacture of this country, I have endeavoured to point out their

advantages and disadvantages, as compared with the machines used in Great Britain. These will be interesting chiefly to practical men. To the minds of proprietors, an interesting inquiry will naturally occur, viz. *What may be the actual difference in the cost of manufacturing in the two countries?* In order to ascertain this as nearly as possible, I have endeavoured to give in the following pages correct estimates of the cost of erecting manufacturing establishments, and putting them in operation; together with their produce and expense of workmanship in both countries; from which a fair estimate may be formed of their comparative advantages, for the manufacturing of cotton goods.

COMPARATIVE ESTIMATES  
OF  
COTTON FACTORIES  
IN THE  
UNITED STATES OF AMERICA,  
AND IN  
GREAT BRITAIN.

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In the following Estimates of the cost of Buildings, Machinery, &c. of Manufacturing Establishments in the United States of America and in Britain, each Factory is supposed to contain 128 power looms, with all the subordinate machinery required. The extent and form of the buildings, together with the number of machines, and the arrangement of the various departments are suited to the practice of each country. Likewise the number of hands employed—the rates of wages paid—the cost of materials—and the amount of goods produced—are also adapted to each country respectively.

In estimating the cost of building a Factory in the United States, the extent of the Mill is supposed to be four stories besides the attic. The first, or basement story, contains the water wheels, cloth room,

and mechanics' shop ; the second, contains the carding ; third, the spinning ; fourth and attic, the weaving and dressing ; leaving the picking-house and cotton store for separate buildings.

The Factory in Britain is supposed to be five stories in height, and arranged in the following manner. The first and second stories contain the weaving and dressing ; the third and fourth, the mule and throstle spinning ; fifth, the carding ; and the attic, the picking and scutching. At one end of the carding and spinning rooms, there may be small apartments partitioned off for a mechanic's shop, cloth room, &c. The engine and boiler house being situated at one end of the Mill, and the cotton store in a separate building.

In the following, and all other computations of money throughout this work, the dollar is reckoned at par value, equal to  $4/2$  sterling, making the cent equal to one halfpenny ; each dollar contains 100 cents, or 100 halfpennies, equal to 50 pence, or  $4/2$ . When exchange is at par between Great Britain and the United States, 108 dollars here are equal to 100 in Great Britain, supposing the dollar  $4/6$ .

*COMPARATIVE ESTIMATES of the cost of BUILDINGS, MACHINERY, &c. and of the EXPENSES IN WAGES, &c. for a Cotton Factory in GREAT BRITAIN and the UNITED STATES OF AMERICA.*

BUILDING AND GEARING.

	AMERICA.		BRITAIN.	
	AMOUNT.		AMOUNT.	
	Dollars.	Sterling.	Sterling.	Sterling.
A Cotton Factory, built of Brick, 142 by 42 feet within the walls, four stories in height, besides an Attic, including all expenses for Materials, Labour, &c.,	25,000	5,208	6	8
Two Water Wheels, equal to 80 horses' power, including Gearing, Gates, Shafting, Belting, &c.	17,000	3,541	13	4
A Cotton Factory, built of Brick, 90 by 38 feet within the walls, five stories in height, including all expenses for Materials, Labour, &c.	...	...	...	...
A Condensing Steam Engine, of 25 horses' power, with Boilers, &c. Gearing, including Wheels, Shafting, Drums, Fitting up, &c., Furniture, Gas and Steam Pipes, Lathes, Tools, &c. &c.,	2,000	416	13	4
	44,000	9,166	13	4
			2,480	0
			0	0

## **PREPARATION DEPARTMENT.**

## OF COTTON FACTORIES.

115

**N. B.—** Some variations from the prices stated for the machines in the above and following Tables, may, no doubt, be found in the various places where they are made; but those assumed are believed to be a fair average for machines of good quality.

- \* In the above estimate the American Cards are understood to be 37 inches broad, and the British 24 inches. The diameter of cylinder in both is 36 inches.

AMERICA.		BRITAIN.		AMOUNT.	
Number.	Rate.	Dollars.	Sterling.	Number.	Rate. Sterling.
Throstle Spindles,	.	.	.	2,160	9/6
Mule Spindles,	.	.	.	2,400	5/6
Machine for covering Rollers,	.	.	.	1	£15
Rove Bobbins,	.	.	.	74 gross	19/-
Spinning Frame Bobbins,	*	.	.	59 "	8/-
Skewers,	.	.	.	35 "	10/-
Spools or Warpers' Bobbins,	.	.	.	40 "	12/-
Miscellaneous Articles,	.	.	.	.	.
				1,026	0
				660	0
				15	0
				70	6
				23	12
				17	10
				24	0
				22	0
				1,858	8
				4,907	1
				23,554	0

DRESSING AND WEAVING DEPARTMENT.

OF COTTON FACTORIES.

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	AMERICA.			BRITAIN.			
	No. of Machs.	Rate.	Dollars.	AMOUNT. Sterling.	No. of Machs.	Rate. Sterling.	AMOUNT. Sterling.
Spooling or Winding Machines,	6	70	420	87 10 0	3	£7	21 0 0
Warping Machines,	6	150	900	187 10 0	3	17	51 0 0
Dressing Machines, including Mounting,	9	400	3,600	750 0 0	6	49	294 0 0
Looms, including Mounting,	128	75	9,600	2,000 0 0	128	10	1,280 0 0
Twisting Frames,	• • •	• • •	• • •	• • •	3	1	3 0 0
Miscellaneous Articles, Boilers, Tubs, &c.	• • •	• • •	100	20 16 8	• • •	• • •	65 0 0
			14,620	3,045 16 8			1,714 0 0

COMPARATIVE EXPENSE in Wages per fortnight in BRITAIN and AMERICA.

PREPARATION DEPARTMENT.

	AMERICA.				BRITAIN.			
	No. of Hands.	Rate per week.	Amount per fortnight.		No. of Hands.	Rate per week.	Amount per fortnight.	
			Dollars.	Sterling.			Sterling.	Sterling.
Attendants at Willow,	1	4	8	1	18	4	1	6/-
Do. at Scutching Machine,	1	5	10	2	1	8	1	6/-
Do. at Spreading Machine,	2	3.50	14	2	18	4	4/-	6/6
Do. at Cards,	1	4	8	1	13	4	2	6/-
Do. at Lap Machine,	12	2.50	60	12	10	0	4	12/-
Do. at Drawing Frames,	3	3	18	3	15	0	6	4/-
Do. at Speeders,	7	3.25	45.50	9	9	7	7/6	12/-
Do. at Extensors,	4	·	·	·	·	·	4	3/-
Do. at Fly Frames, (3 @ 7/-, and 3 @ 4/-,)	2	4.75	19	3	19	2	2	8/-
Top Strippers,	4	·	32	6	13	4	4	0/-
Sharpers and Grinders,	1	12	24	5	0	0	1	21/-
Overseer,	1	6	12	2	10	0	2	2/-
Assistant for Overseer,	1	·	·	·	·	·	·	·
	35		250.50	52	3	9	27	18/-

SPINNING DEPARTMENT.

OF COTTON FACTORIES.

119

	AMERICA.			BRITAIN.		
	Number of Hands	Rate.	Dol.	Amount per fortnight, Sterling.	No. of Hands or Quantity.	Rate. Sterling.
Hands attending Throstle Frames,	30	3	180	37 10 0	12	5/ 6 0 0
Cost of spinning Mule Yarn No. 18's,				... . . . .	5,666 lb. .706d.	16 13 4
Overseer,	1	12	24	5 0 0	1	24/ 2 8 0
Assistant for do.	1	6	12	2 10 0		
Roller Coverer,	1	4	8	1 13 4	1	8/ 0 16 0
						25 17 4
	224	46	13	4		

## DRESSING AND WEAVING DEPARTMENTS.

	AMERICA.			BRITAIN.		
	No. of Hands or Quantity.	Rate.	Dollars.	Amount per fortnight. Sterling.	No. of Hands or Quantity.	Rate.
Winding (the rate stated is £1000 hks.)	181,440 hanks	.18	32.65	6 16 0½	101,520 hks.	7 ½ d.
Warping,	181,440 do.	.16½	30	6 5 0	101,520 do.	7 ½ d.
Dressing,	1,710 pieces	.4	68.40	14 5 0	1,408 pcs.	2 ¼ d.
Drawing and Twisting,	216 beams	.20	43.20	9 0 0	140 bms.	4 ¾ d.
Weaving,	1,710 pieces	.25	427.50	89 1 3	1,408 pcs.	10d.
Flour for Dressing,	1,710 do.	.2	34.20	7 2 6	1,408 do.	2d.
Oversers,	2 hands,	12	48	10 0 0	2 hands	26/-
Assistants for do.	2 do.	6	24	5 0 0		5 4 0
Dressing Maker, and Brush-Washer,	1 do.	4.50	9	1 17 6	1 do.	13/-
Sweepers,	2 do.	2	8	1 13 4	1 do.	6/-
Cloth Pickers,	2 do.	2.50	10	2 1 8		0 12 0
						—
						99 10 5
						—
						734.95
						153 2 3½

## OF COTTON FACTORIES.

121

## GENERAL CHARGES.

	AMERICA.				BRITAIN.			
	No. of Hands.	Rate per week.	Dol.	Sterling.	Amount per fortnight.	No. of Hands.	Rate per week.	Amount per fortnight.
Calenderer or Packer,	1	4.50	9	1	17	6	7/-	2 2 0
Hands for Measuring and Folding Cloth, &c.	2	2.25	9	1	17	6	3	6 18 0
Mechanics,	3	9	54	11	5	0	23/-	
Porter,	1	5	10	2	1	8	1	16/- 1 12 0
Book-keeper,	1	9.50	19	3	19	2	1	23/- 2 6 0
Watchman,	1	5	10	2	1	8	1	12/- 1 4 0
Engine-keeper,	..	..	..	..	..	..	1	21/- 2 2 0
Superintendent or Manager,	1	25	50	10	8	4	1	50/- 5 0 0
								21 4 0
	161		33	10	10			

## ANNUAL ON-COST.

	AMERICA.			BRITAIN.		
	Dollars.	Rate Per Cent.	AMOUNT. Dollars.	Sterling.	Rate per Cent.	AMOUNT. Sterling.
Capital, with rate and amount of Insurance, Tear and wear on Machinery, Buildings, &c.	110,000	£1	1,100	229	3	4 £112,000 17/6 105 0 0
Coals, Oil, Tallow, and Gas,	103,800	£7½	7,785	1,621	17	6 9,000 £7½ 675 0 0
Paper, Twine, Belting, &c.	•	•	2,250	468	15	0 • • • • 368 0 0
Cloth and Skins for Rollers,	•	•	•	750	156	5 0 • • • • 120 0 0
Materials for repairing Machinery,	•	•	•	350	72	18 4 • • • • 50 0 0
Carriage of Cotton and Cloth,	•	•	•	850	177	1 8 • • • • 80 0 0
Feu duty and Water,	•	•	•	600	125	0 0 • • • • 50 0 0
Incidental charges,	•	•	•	•	•	• • • • 55 0 0
Nett annual on-cost,	•	•	•	1,500	312	10 0 • • • • 300 0 0
Nett on-cost for two weeks,	•	•	•	15,185	3,163	10 10 • • • • 803 0 0
			584	121	13	4 • • • • 69 6 11

COMPARISON of PRODUCE per fortnight in BRITAIN and AMERICA.



SPINNING.

		No. of Yarn.	No. of Spindles.	Speed of Spindles.	Lbs. produced.	Hanks produced.	Hanks per spindle
		Threads.	Mule.				
Throstle Warp	Spinning in America,	-	-	-	4,700	10,080	18,1440
Do.	in Britain,	-	-	-	4,400	6,345	10,1520
Do.	do.	-	-	-	4,700	7,744	13,9392
Do.	Weft	-	-	-	2,400	5,666	10,2000
Mule	do.	-	-	-			42½

WEAVING.

	America.	Britain.
Pieces* produced from 128 Looms,		
Yards do.	1,710	1,408
Speed of Looms per minute,	51,300	35,200
Effective Shots obtained,	120	95
	104	77.42

\* The Cloth assumed in the above calculations is, for America, a 900 three leaved tweel No. 18's warp, and weft three threads in the split, 2,400 threads, 30 inches broad, 30 yards long; 62 picks to the inch, weighing about 10 lbs. For Britain, a 1000 shirting, No. 16's warp, No. 18's weft, 2000 threads 35 inches broad, 25 yards long, 63 picks to the inch, weighing about 8½ lbs.

## ABSTRACT OF CHARGES FOR TWO WEEKS.

	AMERICA.		BRITAIN.	
	Dollars.	Sterling.	Sterling.	
Preparation Charges,	250.50	52	3	9
Spinning Charges,	224.	46	13	4
Dressing and Weaving Charges,	734.95	153	2	3½
General Charges,	161.	33	10	10
On-Cost for two weeks,	584.	121	13	4
Nett amount of charges for two weeks,	1954.45	407	3	6½
Nett charges per piece (see pieces produced as shewn in table of Comparative Produce,) .	1.14	...	4	9
Nett charges per yard, (see yards produced as shewn in table of Comparative Produce,) .	.34	...	...	1.9
Difference in manufacturing charges per yard in favour of Britain equal to 19 per cent.	.	.	.	.
				...
				3

## OF COTTON FACTORIES.

125

*Comparative Cost of Manufacturing, including Raw Material.*

It is not designed by the preceding estimates to point out the amount of profit realized by manufacturing cotton goods, as that will often vary according to the state of the markets. The chief design is to show the real cost of manufacturing in the United States and in Great Britain : and the utmost accuracy has been studied in order to give a fair and impartial statement of the actual expense of manufacturing in both countries, so as to ascertain the real difference as nearly as possible.

The comparison has been made upon goods which require the same quality of cotton—the same expense in manufacturing,—and each yard contains the same weight of raw material ; so that they may be supposed to sell at the same price. The various estimates have been submitted to the inspection and correction of experienced manufacturers in both countries, by whom they are considered accurate and impartial statements.

The amount of goods produced is much greater in America than in Great Britain; but the hours of labour are somewhat longer in the former than in the latter country.

The cost of the buildings, machinery, &c. is a great deal higher in America than in Britain, as well as the general rate of wages, particularly in the carding department.

After comparing the advantages and disadvantages of each, it appears that the British manufacturer can produce his goods, at least 19 per cent. cheaper than the American. This, however, is more than neutralised, by the cheaper rate at which the latter can purchase his cotton.

The circumstance of America being a cotton

growing country, will always give to her manufacturers advantages of which the British cannot generally avail themselves. It is very common here for several manufacturers to join together, and appoint some person acquainted with the business, to go to the Southern States, and purchase cotton sufficient for a year's consumption. The person thus appointed goes to the first markets, and selects such cottons as he knows will suit those for whom he is purchasing—he buys it at the cheapest rate, and has it shipped to the nearest port to where it is to be manufactured. The whole charge for commission will not amount to one per cent. on the prime cost.

The ordinary way of purchasing, however, is through a cotton agent in the South; and in order to show the whole expense on transactions of this kind, I will here copy the amount of the charges from some invoices now before me.

*Mobile,*

Invoice of 300 square bales of cotton shipped by J. Hazard & Co. per Brig Pioneer, Jordon, for S ——, Maine, consigned to P —— C ——, Esq. Treasurer, for account and risk of the Y —— Manufacturing Co.

	Dollars.	Cents.
300 square bales of cotton, 141,138 lbs. at 12½ cents = 6½d per lb.	17,289	40
CHARGES.	Dol.	Cts.
Draggage to store,	37½	
Do. to vessel,	37½	
Wharfage,	30	
Storage, 25 cents per bale,	75	
Bills of lading,	50	
Postages till date,	2	25
Brokerage, ½ per cent,	86	45
Commission, 2½ per cent,	438	97
Freight, 1 cent per pound,	1411	38
Total charges,	2119	55
	<hr/>	
	19408	95

The whole amount of charges on the above 300 bales is about  $12\frac{1}{4}$  per cent. on the prime cost; and it is to be remarked, that the whole were landed within 200 yards of the Factory where they were to be used.

*New Orleans,*

Invoice of 122 bales of cotton, shipped by Stelston, Avey & Co. per Ship Ohio, C. Cutter, bound to Boston for account and risk of the Y—— Manufacturing Co. To the order of W——B——S——, Esq. and to him consigned.

	Dollars.	Cents.
122 Bales cotton, 53,913 lbs. at $10\frac{3}{4}$ cents = $5\frac{5}{8}$ d		
per lb. ....	5795	64
CHARGES.	Dol. Cts.	
Draggage, 12 dollars 20 cents: repairs on bagging, 1 dollar, ....	13	20
Brokerage, $\frac{1}{2}$ per cent = 28 dollars 97 cents. Commission, $2\frac{1}{2}\frac{3}{4}$ cent = 144 dollars 88 cents = ....	173	85
Freight, $\frac{3}{4}$ cent. per lb. ....	404	35
Total charges, ....	<hr/> 591	<hr/> 30
	<hr/> 6,386	<hr/> 94

The charges on the above 122 bales, amount to about  $10\frac{3}{4}$  per cent. on the prime cost; and the storage, &c. in Boston, together with the carriage to the Factories, amounted to about  $\frac{1}{2}$  per cent.; making the whole charges for having the cotton laid down at the Factories, something less than  $10\frac{3}{4}$  per cent.

*Savannah, Georgia,*

Invoice of 100 bales of cotton, purchased and shipped by Woodbridge and May, on board Barque Richmond, Captain Andross, bound

for Boston, consigned to W——B——S——, Esq. Presented by his order for account and risk of the Y—— Manufacturing Co.

100 bales gross wt. 36,810 lbs.

Tare,	200	Dol.	Cts.
Nett, 36,610 lbs. at 10 <sup>25</sup> / <sub>100</sub> cts. = 5½d. $\frac{1}{2}$ lb. 4008 80			
<b>CHARGES.</b>			
Draggage, 8 cents, wharfage, 5 cents, $\frac{1}{2}$ bale, 13			
One week's storage, at 6 $\frac{1}{4}$ dollars, .....	6	25	
Mending bagging, twine, and labour, .....	4	75	
Commission on 4008 <sup>80</sup> / <sub>100</sub> dollars at 2 $\frac{1}{2}$ cent, 80		17	
Freight, $\frac{5}{4}$ cent. $\frac{1}{2}$ pound, .....	274	58	
Total charges, .....		378	75
		4387	53

The charges on the above 100 bales, are nearly 9 $\frac{1}{2}$  per cent. on the prime cost, to which add  $\frac{1}{2}$  per cent. for additional expenses of storage and carriage to the Factories, making the whole amount to about 10 per cent.

The above are fair specimens of ordinary transactions, from which it will be seen, that the whole expenses attending the purchase and carriage of cotton, until it is laid down at the Factories, seldom exceed 12 or 13 per cent. on the prime cost, and in many cases are much less. The Cotton Factories in this country are generally situated near the sea coast, so that the expense of inland carriage is very trifling, compared with that paid by the majority of Factories in Great Britain. The carriage from Boston to Lowell is two dollars per ton, while to many other Factories, the inland carriage is not above one dollar; at the same time, there are various other Factories, in different parts of the country, to which the carriage cannot be less than four dollars per ton.

The foregoing Tables bring out a view of the manufacture of the two countries, which is worthy of observation by the manufacturers on either side of the Atlantic; viz. that in every description of goods in which the cost of the raw material exceeds the cost of production, the American manufacturers have a decided advantage over the British. And they have availed themselves of this advantage to improve the quality of their goods, as any person who has had an opportunity of comparing the domestics manufactured in the two countries, can have no hesitation in giving the preference to those manufactured in America; and the experience of every British manufacturer engaged in producing this description of goods has painfully convinced him, that the superior quality of the American goods is gradually driving him from every foreign market. On this subject Mr. William Gemmell of Glasgow states in his affidavit, (as given in Mr. Graham's pamphlet on "The impolicy of the tax on Cotton Wool,") that although he was for several years in the habit of supplying Chili with cotton domestics, he has latterly been obliged to abandon the trade, in consequence of being unable to compete with the manufacturers of the United States.

Being well acquainted with the kind of domestics manufactured by Mr Gemmell, and also with those of the same kind manufactured in various places in the United States, I do not think it is difficult to understand why Mr Gemmell was obliged to abandon the trade. But if those kinds of domestics manufactured by Mr John King of Glasgow, could be sent to Chili on the same terms, they would be found to stand a competition with any of the kind that has

yet been manufactured in any part of America. The coloured tweel stripes also, made on the principle invented by Mr John M'Bride of Messrs. Sommerville and Sons, Glasgow, would, from their beautiful texture and finish, successfully compete with any of the same description I have yet seen produced, either in this country or in Great Britain.

Hitherto the British have enjoyed a monopoly in the manufacture of fine goods, but the resources of the Americans will very soon enable them to compete successfully even in these. No people in the world are more enterprising, none more ready to pick up and avail themselves of every improvement by which their interest is to be advanced; and there is no doubt, that, in a few years, they will adopt a more economical method of getting up their works, a more improved system of general management and conducting of the various processes, which will enable them, even in the finer goods, to compete successfully with the British.

It is worthy of remark, that, in printed goods, the French have the advantage over both countries; the French prints selling in this country 25 per cent. higher than either the British or American.

There are a few statements made by Dr. Ure, in his work entitled, "The Cotton Manufacture of Great Britain systematically investigated," which I think scarcely correct, and which I will here notice.

At page xxxix. he states: "The capital required to carry on the manufacture in the best manner is considered to be at the rate of 100 dollars for each spindle; but, in general, not more than 60 dollars have been expended." I conceive 40 dollars are

amply sufficient for each spindle, allowing something above 20 for fixtures, and the remainder for business capital.

At page xli. he gives the general rate of wages paid in the United States, upon the authority of Mr Kempton, a manufacturer from Philadelphia, which statement may be correct as to the rate of wages paid in the Southern section of the United States, but differs very materially from those of New England, where very few hands are employed under fifteen or sixteen years of age, except in some Mills about Rhode Island. The Factories about Philadelphia cannot be admitted as a proper criterion of the general state of the cotton manufacture of America. The character and appearance of the manufacturing population there, as well as the general manner of conducting the business, are very different from that of Massachusetts, which contains nearly one third of the Cotton Factories in the whole Union. In order to ascertain the actual state of the cotton manufacture of America, we must take our estimates of the cost of materials, rates of wages, &c. &c. from that State. The rate of wages given by Mr Kempton, compared with that generally paid in the Factories of Massachusetts, is shown in the following Table.

Rates of Wages according to Mr KEMPTON's STATEMENT.	Rates of Wages paid in MASSACHUSETTS.		
Card Tenter, .....	$\left\{ \begin{array}{l} 10 \text{ Years of age} = 3/\text{W week}, \\ 12 \text{ do. do.} - 4/\text{do.} = 96 \end{array} \right.$	72 cents.	None employed.
Attending Drawing Frames	$\left\{ \begin{array}{l} 14 \text{ do. do.} - 5/\text{do.} = 120 \\ 16 \text{ do. do.} - 6/\text{do.} = 144 \end{array} \right.$	do. do.	Do. 1 dollar 80 cents.
Attending Roving Frames, ....	18 do. do. - 8/ do. do. = 192	do.	2 dollars to 2 dollars 20 cents.
Girls attending Throstle Frames,.....	5/to 8/do. = 120 to 192 do.	do.	2 do. 20 cents to 2 dollars 50 cents.
Machine-Makers, .....	5/ W day = 120	do.	2 do. 50 do. to 2 do. 75 do.
Overseers, .....	5/to 6/do. = 120 to 144 do.	do.	1 do. 20 do. to 1 do. 50 do.
Assistant Overseers, .....	3/to 4/do. = 72 to 96 do.	do.	84 cents to 1 dollar 25 cents.

Upon the same authority as the preceding, it is stated by Dr. Ure; "No. 16 water-twist, made entirely of good cotton, sells in the United States at  $10\frac{1}{2}$ d. per pound; in England, No. 16 yarn, made from a mixture of waste and a small quantity of Uplands, sells at 11d. per pound."

I have made inquiry regarding this statement at some old and experienced manufacturers, none of whom can recollect the time when No. 16 water-twist could be manufactured and sold in any part of the United States at  $10\frac{1}{2}$ d. equal to 21 cents per pound. There is certainly some mistake in this statement; instead of  $10\frac{1}{2}$ d. it ought to have been 13d. equal to 26 cents; and even this is too low.

It is stated at page xlvi. "The money prices of provisions have been much higher in Great Britain than in the manufacturing countries of the continent of Europe and America." Now it may be true, that the prices of provisions *have been* higher in Great Britain than in America; but they are not so now. I can speak from experience on this subject, and have no hesitation in asserting, that the price of living is higher in this country than in Britain; I know of nothing that is cheaper here but spirits, tea, and tobacco. I have no doubt but in the interior of the country, potatoes, Indian corn, butter milk, poultry, &c. may be much cheaper; but in all the cities and manufacturing places, they are much higher. It will be supposed that flour must be considerably cheaper here than in Great Britain; but it is not always so, as during these few years past, there has been a vast quantity of wheat imported from Great Britain and the continent of Europe.

House rents are higher here than in Scotland, and fuel is at least triple the price of what it is in Glasgow. All kinds of clothing are higher, and particularly the making of clothes. The price of *making* a coat in Boston is from eight to twelve dollars; as much as would *purchase* one complete in Glasgow.

Dr. Ure proceeds to state, that "In the event of that more serious struggle, which in the natural progress of competition is likely to take place, the cheapness of the means of subsistence, by conferring a higher condition upon the foreign workman, leaves more room for a reduction of wages. Mr. Kirkman Finlay, a great authority in these matters, says, 'I think the difference would be this, that if the amount of wages paid in Great Britain were absolutely necessary for the comfortable subsistence of the workmen, it would be quite clear that whatever pressure there might be, those wages could not be permanently reduced; but if the money wages paid in America are sufficient to get a great deal more than the absolute necessities and comforts of life, then, if there is a pressure upon its manufacturers, they can so reduce the wages as to meet that difficulty, and by that means undersell the manufacturers here.'" (Britain.)

That the general rate of wages is higher in the United States than in Britain is admitted, particularly the wages of females employed in the Factories. The greater part of these are farmers' daughters, who go into the Factories only for a short time until they make a little money, and then "clear out," as it is called; so that there is a continual changing

amongst them, and in all the places I have visited, they are generally scarce; on that account the manufacturers are under the necessity of paying high wages, as an inducement for girls to prefer working in the Factories to house-work: and while this state of things continues, it is not to be expected that wages in this country will be so low as in Great Britain ; and although they have undergone a considerable reduction during the late depression, still they are higher than in any part of Britain.

Mr. Kirkman Finlay, in his letter to Lord Ashley in 1833, states, that the prices of spinning a given quantity of yarn from No. 10's to 20's, was 4/- in the United States, and 4/11 in Glasgow; and the prices of carding the same numbers, were 6/7½ in the former, and 7/1¼ per week in the latter. I think there must be some misunderstanding in this. The prices of mule spinning in the New England States, was, previous to 1837, 10 cents per 100 hanks, or 100 cents = 4/2 per 1000 hanks, while, at the same time, the price of mule spinning in Glasgow, was 3/6½ for all numbers under 40's, being about 17 per cent. in favour of Glasgow. But during 1837, the price of mule spinning was greatly reduced in the New England Factories; so far as I could learn, the average rate was about 7 cents per 100 hanks = 2/11 per 1000, which, supposing the rate still paid in Glasgow to be 3/6½ would be 21 per cent. in favour of America.

Throstle spinning is nearly as cheap in this country as in Britain, in consequence of the higher speed at which the spinning frames are driven, and the greater quantity of work produced in a given time.

But the price of carding is fully double that paid in Britain, because here men are generally employed to attend the cards, spreading, scutching machines, &c. while the same work is done by boys and girls in Britain. The lowest wages paid to any girl in the card room that I am aware of, is one dollar per week and her board; and taking her board at the lowest rate, viz. 1 dollar 20 cents per week, her wages in all will amount to 2 dollars 20 cents, equal to 10/2 sterling per week. The average rate of wages for girls in the card room, may vary from 11/ to 12/6 per week. Men's wages may vary from 13/ to 18/ per week. Thus, in every department, the rate of wages is generally higher in the United States than in Britain; nor do I think that they will, at least for many years, be so low in this country as in Great Britain.

The price of living here is higher, and the hours of labour longer; besides, the greater part of the Factory workers being connected with farming, whenever wages become reduced so low, as to cease to operate as an inducement to prefer Factory labour above any other to which they can turn their attention, then a great many Factories will have to shut up. During a stagnation of trade, it is common for the manufacturers here to stop a part, or the whole of their Factories, and then the workers retire to their farms: such was the case in 1837, when a vast number of Factories were entirely shut up. Yet it seemed not to affect the workers very materially; indeed, many of the girls who had been some time in a Factory, seemed to rejoice and regard it as a time of recreation; so that the manufacturing popu-

lation of America are an entirely different class, and placed in very different circumstances from those of Great Britain, and very great changes must take place before the wages in the former can be so low as in the latter country: and, indeed, the manufacturers here can afford to pay higher wages than the British, because they run their Factories longer hours, and drive their machinery at a higher speed, from which they produce a much greater quantity of work ; at the same time, they can purchase their cotton at least one penny a pound cheaper, and their water power does not cost above one-fourth of the same in Great Britain. But though wages cannot be reduced much lower than they are at present, there are other means by which manufacturers might abridge their expenditure. Their establishments might be erected at much less expense—a more improved arrangement might be adopted—and the work conducted with much more economy. All these, however, are matters which the Americans will very speedily learn ; every successive depression of trade will lead them more and more to see the necessity of managing every department of the business with the least possible expense; and as soon as they can equal the British in this, they will be able to compete with them, and that successfully too, in any market whatever.

The British have, no doubt, attained to great perfection in the art of manufacturing cotton goods; but whether they will be able to maintain that high pre-eminence to which they have arrived, or have to yield to the increasing improvements of foreign nations, are questions of difficult solution. Their most

powerful rivals are, doubtless, the Americans. The manufacturers of no other country can purchase their cotton so cheap, and it is presumed no country possesses so extensive water privileges; only a small portion of which has yet been occupied. If we add to these, the intelligence and enterprising spirit of the people, it will at once be obvious to every unprejudiced mind, that the American manufacturers are the most formidable competitors with which the British have to contend in foreign neutral markets.

The preceding brief details will be interesting chiefly to proprietors and practical manufacturers. What follows, being more of an historical and statistical nature, will, it is hoped, be found interesting both to them, and also to the general reader.



HISTORICAL SKETCH  
OF THE  
RISE AND PROGRESS  
OF THE  
COTTON MANUFACTURE  
IN  
AMERICA.

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THE following brief sketch of the American Cotton Manufacture has been compiled chiefly from "White's Memoir of Slater," a work replete with interesting information, to which all who wish a more complete illustration of this subject are respectfully referred.

As early as the year 1787, a Society was formed in Philadelphia, under the name of the "Pennsylvania Society for the Encouragement of Manufactures and the Useful Arts," which made some progress in the manufacturing of various kinds of goods, such as jeans, corduroys, fustians, plain and flowered cottons, flax linens, tow linens, &c. But the machinery employed in this manufacture seems to have been of the very rudest kind. A short time before the formation of this Society, an attempt to spin cotton yarn by machinery had been made at

Bridgewater and Beverly, in the State of Massachusetts. Two mechanics from Scotland, Alexander and Robert Barr, brothers, were employed by a Mr Orr, at East Bridgewater, to make carding, spinning, and roving machines, which they completed, and on the 16th November, 1786, the general court of Massachusetts made them a grant of £200, lawful money, for their encouragement, and afterwards added to the bounty, by giving them six tickets in the State land lottery, in which there were no blanks.

In March 1787, Thomas Somers, an English midshipman, constructed a machine, or model, under the direction of Mr Orr; and by a resolution of the general court, £20 were placed in the hands of the latter, to encourage him in the enterprise.

The above remained in the possession of Mr Orr for the inspection of all disposed to see them, and he was requested by the general court, to exhibit and give all information or explanation regarding them. It is believed that the above were the first machines made in the United States for the manufacture of cotton.

The Beverly Company commenced operations in 1787, and are supposed to be the first Company that made any progress in the manufacture of cotton goods; (that at Bridgewater had been on a very limited scale;) yet the difficulties under which they laboured—the extraordinary loss of materials in the instruction of their servants and workmen—the high prices of machines unknown to their mechanics, and both intricate and difficult in their construction, together with other incidents which usually attend a

new business, were such, that the Company were put to the necessity of applying to the State legislature for assistance, to save them from being compelled to abandon the enterprise altogether.

In their petition to the Senate and House of Representatives of Massachusetts, presented June 2d, 1790, only three years after they had commenced operations, they state, "That their expenditure had already amounted to nearly £4000, whilst the value of their remaining stock was not equal to £2000, and a further very considerable advance was absolutely necessary, to obtain that degree of perfection in the manufacture, which alone could ensure success."

Accordingly a grant of £1000 was presented to them, to be appropriated in such a way as would most effectually promote the manufacturing of cotton piece goods in the Commonwealth.

The petition above referred to, and other collateral facts, sufficiently prove, that cotton spinning in this country, further than the hand card and one thread wheel, was carried through its first struggles by the Beverly Company in Massachusetts. And from this State the manufacture was carried to Rhode Island, though it must be acknowledged that both States were indebted to foreign emigrants for instruction and assistance in spinning and weaving, as well as in preparing the cotton.

Cotton spinning commenced in Rhode Island in 1788, in which year Daniel Anthony, Andrew Dexter, and Lewis Peck, all of Providence, entered into an agreement to make what was then called "Home Spun Cloth." The idea at first was to make jeans

of linen warp spun by hand; but hearing that Mr Orr of Bridgewater, and the Beverly Company, had imported some models or draughts of machinery from England, they sent thither, and obtained drawings of them, according to which they constructed machinery of their own. The first they made was a carding machine, which was something similar to those now used for carding wool, the cotton being taken off the machine in rolls, and afterwards roped by hand. The next was a spinning frame, something similar to the water frame, or rather the common jenny, but a very imperfect machine. It consisted of eight heads of four spindles each, being thirty-two spindles in all, and was wrought by means of a crank turned by the hand; this, after being tried for some time in Providence, was taken to Pawtucket, and attached to a wheel propelled by water: the work of turning the machine was too laborious to be done by the hand, and the machine itself was too imperfect to be turned by water. Soon after, these machines were sold to Moses Brown of Providence; but as all the carding and roving was done by hand, it was very imperfect, and but very little could be done in this way. Such were the rude machines used for spinning cotton previous to 1790; and the wonder is, not that the manufacturers failed in their undertakings, but rather that they were able to persevere. And we can now perceive that from these small beginnings, the present brightened prospects received their foundation.

Previous to 1790, the common jenny and stock card had been in operation in various parts of the United States: and mixed goods of linen and cotton,

were woven principally by Scotch and Irish weavers. Mr Moses Brown of Providence, had several jennies employed in 1789, and some weavers at work on linen warps. The jennies were used for making weft, and operated by hand in the cellars of dwelling houses. During 1790, Almy and Brown of Providence, manufactured 326 pieces, containing 7823 yards, of various kinds of goods. There were also several other Companies and individuals in different parts of the Union, who manufactured goods from linen warps and cotton weft. But notwithstanding these most laudable and persevering efforts, every attempt failed of success, and they saw their hopes and prospects entirely prostrated. There was no deficiency of enterprise or exertion; no want of funds, or of men ready and willing to engage in the business; and no lack of patronage from the government, they having learned from the privations to which the country was subjected during the revolutionary war, the absolute necessity of promoting and encouraging domestic manufactures. The great cause of these failures is to be found in the fact, that during all these incipient struggles to establish the cotton manufacture in America, Great Britain had in full operation a series of superior machinery, which the manufacturers in this country had in vain endeavoured to obtain.

It is to be remembered that Sir Richard Arkwright took his first patent for an intirely new method of spinning cotton yarn for warps in 1769, at which period his first Mill was put in operation at Nottingham in England, and his second Mill,

which was much larger, was erected at Cromford, Derbyshire, in 1771. After which his mode of spinning by water frames extended rapidly all over the kingdom; so that during the period when the most persevering exertions were being made, by various enterprising individuals, in different parts of the United States, to improve and perfect this most important manufacture, England was enjoying all the benefit of Arkwright's patents, by means of which cotton yarn was produced at much less expense, and of a superior quality to any that had ever been made by machinery before that period: and, at the same time, the British government were using every means in their power, to prevent models or drawings of these machines from being carried out of the country. Every effort to erect or import this machinery into the United States had hitherto proved abortive. Much interest had been excited in Philadelphia, New York, Rhode Island, and Massachusetts, but they found it impossible to compete with the superior machinery of England. The difficulties under which these incipient measures, towards the establishment of the business, were pursued, can hardly be conceived at the present day, even by a practical machinist or manufacturer. Besides the difficulties experienced in consequence of imperfect machinery, the period at which the business commenced in this country, was also most unfavourable, as from the peculiar state of the manufacture in England at that time, and other causes, many in that country became bankrupts, their goods were sold at auction, and shipped to the United States in large quantities, where they were again sold at reduced prices. Agents were also

sent from England to the various manufacturing towns with goods, which were sold at low prices and long credit given, extending in some instances to eighteen months. It is likewise said, that British manufacturers formed themselves into societies, for the purpose of sending goods to this country, to be sold on commission, when they could not be disposed of to advantage at home.

Such was the state of the cotton manufacture in the United States in 1790: every endeavour to introduce a proper system of spinning had been fruitless; and nothing but the introduction of the water frame spinning, which had superseded the jennies in England, could have laid a foundation for the successful prosecution of the business in America; and that was happily accomplished by one who was personally and practically acquainted with the business in all its details. The individual here referred to was Mr Samuel Slater, who has justly been called the FATHER OF THE COTTON MANUFACTURE OF AMERICA.

Mr Slater was born in the town of Belper, Derbyshire, England, on 9th June, 1768; and when about fourteen years of age, he was bound an apprentice, at Milford, near Belper, to Jedediah Strutt, Esq., (the inventor of the Derby ribbed stocking frame, and for several years a partner with Sir Richard Arkwright in the cotton spinning business.) At that time Mr Strutt was erecting a large Factory at Milford, where Slater continued to serve him for some time in the capacity of clerk, but during the last four or five years of his apprenticeship, his time was solely devoted to the Factory, as general overseer, both as respects the making of the machinery and in the man-

ufacturing department. After having completed the full term of his engagement, viz. six and a half years, he continued for some time longer with Mr Strutt, for the purpose of superintending some new works that were then erecting : his design in doing so, was to perfect his knowledge of the business in every department, as previous to this time his thoughts had been directed to America, by various rumours which had reached Derbyshire, of the anxiety of the governments of the different States in that country to introduce and encourage manufactures. A newspaper account of a liberal bounty of £100 having been granted to a person who succeeded in constructing a very imperfect carding machine, for making rolls for jennies, and the knowledge that a society to promote manufactures had been authorised by the same legislature, finally determined him to try his fortune in the western hemisphere.

Mr Slater had a perfect knowledge of the Arkwright mode of spinning ; and from the confidential situation he occupied under Mr Strutt, few enjoyed the same opportunities of acquiring a complete knowledge of all the minutiae of the business ; and being a person of retentive memory, close observation, and attentive to his engagements, it can easily be supposed that he must have been eminently qualified to introduce the cotton manufacture into America upon the same improved scale in which it was then in operation in England, especially as his mind had been for some time directed to that object. For, having once determined to leave his native country, and give to the land of his adoption all the benefit of his practical knowledge and enlarged experience,

there is every reason to suppose that he would embrace every opportunity of preparing himself for the great object he had in view. He knew that it was impossible to take any patterns or drawings along with him, as the government restrictions were very severe, and the custom-house officers scrupulously searched every passenger for America. It was therefore necessary that he should be fully qualified to superintend the building and arrangement of the Mills, the construction of the machinery, and to direct the details of the manufacture, without the aid of a single individual : as the whole business was new to the people of this country, he could not expect any one to assist him except by his own directions. He, accordingly, stopped with Mr Strutt, until he considered himself qualified to engage in this important enterprise.

He embarked at London for New York, on the 13th September, 1789, and landed at the latter on the 17th November, after a passage of sixty-six days. He was immediately after his arrival introduced to the New York Manufacturing Company; but finding that the state of their works did not suit his views, he left that place in the January following for Providence, Rhode Island, and there made arrangements with Messrs. Almy and Brown, to commence preparations for spinning cotton entirely upon his own plan : on the 18th of the same month, the venerable Moses Brown took him out to Pawtucket, where he commenced making the machinery, principally with his own hands; and on the 20th December, 1790, he started three cards, drawing, and roving, together with seventy-two spindles, entirely upon the Ark-

wright principle, being the first of the kind ever operated in this country. These were worked by the water wheel of an old fulling mill in a clothier's building, in which place they continued spinning about twenty months; at the expiration of which time several thousand pounds of yarn were on hand, notwithstanding every exertion had been used to weave it up and sell it.

Early in 1793, Almy, Brown, and Slater, built a small Mill in the village of Pawtucket—known to this day by the name of the Old Factory—in which they put in operation seventy-two spindles, with the necessary preparation, and to these they gradually and slowly added more and more as the prospects became more encouraging. After a short time, besides building another Factory, they considerably enlarged the first.

Such then were the circumstances under which the Arkwright mode of spinning was introduced into this country, and such was the individual to whom belongs the entire merit of its introduction. Previous to 1790, the year in which Mr Slater arrived at Providence, and which is justly denominated the era of the American cotton manufacture, there had been introduced at various places, particularly at New York, Providence, and Massachusetts, jennies, billies, and cards, for spinning cotton weft, to be woven into velverets, jeans, fustians, &c. with linen warp; but the history of those times shows the imperfection of the above-named machines to have been such, as to preclude the manufacture of cotton cloth, or cotton yarn for warps—that they were defective in their operations—deficient and expensive in their

application—and that, under such difficulties and perplexities, it was entirely beyond the power of American manufacturers to compete with foreign goods introduced by British agents and American merchants, even though assisted by legislative aid, as was done at Beverly.

The citizens of Massachusetts, perplexed and involved in their incipient and imperfect attempts to manufacture cotton goods, and fully aware of the importance of introducing a better system of machinery, which they knew to be in successful operation in Great Britain, exerted themselves to obtain a model of the Arkwright patent spinning frame; but finding no person able to construct that series of machinery, and unable to obtain one from England, in consequence of the severe penalties imposed by the government on the exportation of machinery, they entirely failed in all their efforts. In this gloomy period of the American manufacture, Mr Samuel Slater, as already stated, then in the employ of Strutt and Arkwright, having seen a premium offered by the Pennsylvania Society for a certain machine to spin cotton, was induced to leave the land of his fathers, where he had every prospect of succeeding in business, and embark for America. After his arrival, being informed that Moses Brown of Providence had made some attempts at water spinning, he repaired thither; but on seeing Mr Brown's machinery, he pronounced it entirely worthless, and advised him to lay it aside. At this period, without the aid of a single individual skilled in making machinery, Mr Slater constructed the whole series of spinning machines upon the Arkwright principle, and put

them in operation so perfectly, as to supply all the establishments with cotton warp superior to linen ; and in fourteen months Mr Brown informed the Secretary of the Treasury, that machinery and Mills could be erected in one year, to supply the whole United States with yarn, and thus render its importation unnecessary. Such is the amount of evidence regarding the introduction of the Arkwright machinery into the United States ; and if the manufacturing establishments are in reality a blessing, as has been well observed, the name of Slater must ever be held in grateful remembrance by the American people.

Mr Slater laboured under every disadvantage in the construction of his machinery ; for although he had perfect confidence in his own remembrance of every part and pattern, and in his ability to perfect the work according to his agreement, yet he found it difficult to get mechanics who could make anything like his models. But, perhaps, one of his greatest difficulties was to get card sheets made to suit his machines, as the card-makers in this country were entirely unacquainted with the operations of his machinery ; indeed, the first carding machine he put in operation, had almost turned out an entire failure, in consequence of the defective manner in which the card teeth were set. But he persevered until he overcame this, as well as all his other difficulties ; and his case furnishes one other bright example of the never-failing success which always attends patience and perseverance in the pursuit of any laudable object.

In 1798 Mr Slater entered into partnership with

Oziel Wilkinson, Timothy Green, and William Wilkinson; the two latter, as well as himself, having married daughters of Oziel Wilkinson. He built his second Mill on the East side of Pawtucket river; the firm was Samuel Slater & Co., as he owned one half of the stock. A short time afterwards the hands in this Mill revolted, or struck work for higher wages; five or six of them went to Cumberland, and erected a small Mill, owned by Elisha Waters and others: from these men and their connections, several Factories were commenced in various parts of the country, and, in fact, most of the establishments erected from 1790 to 1809, were built by men who had directly or indirectly, drawn the knowledge of the business from Pawtucket, the cradle of the American Cotton Manufacture. Some of his servants stole his patterns and models, and by that means his improvements were soon extended over the country; so that the business has, from that to the present time, been rapidly extending over the United States.

Mr Slater's business was so prosperous, that about the year 1806, he invited his brother, Mr John Slater, to come to this country, who, in all probability, brought with him a knowledge of all the most recent improvements made by the English spinners. The now flourishing village of Slaterville in Smithfield, was then projected, in which John Slater embarked as a partner, and in June of the same year, removed to Smithfield as superintendent of the concern. In the spring of 1807, the works were sufficiently advanced for spinning; and up to the present time, they have been under the management of that gentleman in an uninterrupted

state of improvement. This fine estate was owned in equal shares by four partners, but now wholly belongs to John Slater and the heirs of his brother.

Cotton spinning, according to the preceding statements, commenced in the then obscure village of Pawtucket in 1790, at which time only seventy-two spindles were put in operation. Since that time, the rapid extension of the business in this country has been equalled only by that of Great Britain. According to the report of a Committee, appointed by Congress in 1832, to inquire into the progress of spinning and of the manufacture of cotton goods,—

The number of Mills in twelve States, were .....	795
Spindles in      do. ....	1,246,503
Looms in      do. ....	33,506
Males employed in the Manufacture, ....	18,539
Females      do. ....	38,927
Total employed,.....	57,466

Previous to 1815, the whole weaving in the United States was done by hand looms, in many of which considerable improvements had been made, and great quantities of cloth were manufactured for home consumption. About 1814, a Mr Gilmour landed in Boston from Glasgow, with patterns of the power loom and dressing machine, whom Mr John Slater invited to Smithfield, and made known to him his wishes to construct these important machines; but not being able to prevail on the whole of the partners to engage in the business, Mr Gilmour remained some time at Smithfield, employed as a mechanic, where he introduced the hydrostatic press, which proved to be of great advantage in pressing cloth, &c.

Judge Lyman of Providence had been endeavouring to construct a power loom, but failed in the attempt. On hearing of Mr Gilmour, he, with some other gentlemen, entered into a contract with him, to build a power loom and dressing machine from the patterns he had brought from Great Britain, which he did to the great satisfaction of his patrons, from whom he received a compensation of 1500 dollars. These machines were soon after introduced into Pawtucket, where David Wilkinson commenced making them for sale. Gilmour was a man of great mechanical genius, but neglected to turn his talents and opportunities to the advantage of his family, and, consequently, on his death, they were left in poor circumstances.

The hand looms were soon superseded by the others, the introduction of which greatly aided in extending the business in this country, and has enabled the American manufacturers to compete with Great Britain in South America, India, and some other foreign markets.

STATISTICAL NOTICES  
OF VARIOUS  
MANUFACTURING DISTRICTS  
IN THE  
UNITED STATES.

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THE preceding historical sketch details the introduction of the cotton manufacture into the United States, and the names of the several gentlemen through whose enterprising exertions it was first established. But in order to know its success, or the extent to which it has arrived, it is necessary to give some account of the various manufacturing districts. As the Cotton Factories of America, however, are widely scattered over a great extent of country, it is impossible here to take notice of them all. Some observations on a few of the principal districts is all that will be attempted.

It has already been stated in a former part of this work, that Massachusetts is the principal manufacturing State in this country. An Act was passed by the Senate and House of Representatives of that State in 1837, for the purpose of obtaining "Statistical information in relation to certain branches of Industry within the Commonwealth." The following Table is copied from the report of the Secretary of the Commonwealth, which he prepared from the returns of the assessors in the various towns and cities in the State.

*STATEMENT of the Cotton Manufacture of the State of Massachusetts in 1837. Compiled from the Returns  
of the Assessors in each Town and County, by JOHN P. BIGELOW, Secretary of the Commonwealth.*

COUNTIES	Number of Mills.	Number of Spindles.	Pounds of Cotton consumed yearly.	Yards of Cloth manufactured yearly.	Value of Cotton Goods manufactured yearly.	Males employed.	Females employed.	Capital invested in the Cotton Manufacture.
					Dollars.			Dollars.
Suffolk,								
Essex,	7	13,300	801,222	2,301,520	372,972	115	402	337,500
Middlesex,	34	165,868	17,696,245	52,860,194	5,971,172	1054	6435	6,909,000
Worcester,	74	124,720	5,292,018	20,280,312	1,991,024	1384	1998	2,015,100
Hampshire,	6	8,312	563,000	1,574,000	176,060	72	233	216,000
Hampden,	20	66,552	4,727,302	15,107,583	1,504,386	626	1886	1,698,500
Franklin,	4	5,924	135,045	1,081,140	76,125	48	140	90,000
Berkshire,	31	35,260	1,390,162	7,330,667	575,987	339	766	633,725
Norfolk,	32	25,782	1,365,953	4,953,816	509,383	280	583	609,500
Bristol,	57	104,507	4,814,238	18,382,898	1,678,226	987	2015	1,622,778
Plymouth,	15	13,298	480,884	2,052,061	182,474	85	279	230,616
Barnstable,	2	1,508	6,848	195,100	19,240	7	20	7,000
Dukes County, Nantucket,								
Total,	282	565,031	37,275,917	126,319,221	13,056,659	4,997	14,757	14,369,719

The total population of the State of Massachusetts at this period, was 701,331. The total number of hands employed in all the different branches of industry, was 117,352. This number, (with the exception of those engaged in the rearing of sheep and the fisheries,) does not include any of those employed in the various branches of agriculture and commerce ; neither does it embrace store-keepers, clergymen, physicians, lawyers, bankers, hotel-keepers, labourers, stage coach drivers, nor those employed on rail roads, in steam vessels, &c. It only includes those employed in the various manufacturing and mechanical arts, from the ship builder down to the manufacturer of snuff and cigars, together with wool growers, and those employed in the fisheries.

Out of the 117,352 engaged in the various branches of industry, there were employed in manufacturing cotton goods, 19,754 hands.  
 Cotton batting, thread, warp, and candle wicks, . . . . . 151  
 Calico printing, . . . . . 1,660  
 Total employed in the Cotton Manufacture, . . . . . 21,565 hands,  
 being fully 3 per cent. of the whole population, and upwards of 18 per cent. of all those employed in the different manufacturing and mechanical arts.

The annual value of the produce of all these arts and manufactures was estimated at . . . . . 86,282,616 dollars.

Value of cotton goods manufactured, 13,056,659 dollars.  
 Cotton batting, thread, warp, and wicking, 169,221 do.  
 Calico printing, . . . . . 4,183,121 do.  
 Total annual value of the Cotton Manufacture, 17,409,001 dol.  
 being about 20 per cent. of the value of all the manufactures of the State.

The amount of capital invested in the various branches of industry was estimated at . . . . . 54,851,643 dollars.

In the manufacture of cotton goods, 14,369,719 dollars.

Cotton batting, thread, warps, and wicking, 78,000

Calico printing, . . . . . 1,539,000

Total capital invested in the Cotton Manufacture, 15,986,719 dol. being a little over 29 per cent. of the capital invested in all the different branches of industry.

The following Table gives the number of Factories, capital invested, produce, hands employed, &c. &c. in the State of New York.

*STATEMENT of the Cotton Manufacture in the State of NEW YORK: from Williams' Annual Register for 1835.*

COUNTIES.	Number of Mills.	Capital invested.	Pounds of Cotton consumed annually.	Number of spindles in use.	Pounds of Yarn sold annually.	Yards of Cloth produced annually.	Num. of hands employed.
Oneida, .	20	735,500	1,705,290	31,596	175,080	5,273,200	2,354
Renselaer, .	15	525,000	854,300	16,606	147,110	2,790,315	1,621
Dutchess, .	12	445,000	833,000	17,690	185,500	1,952,000	1,974
Otsego, . .	11	304,000	618,543	15,344	56,000	2,322,000	1,077
Columbia, .	7	218,000	559,000	13,266	199,000	1,150,400	1,265
West Chester,	5	115,000	486,000	9,400	438,000	. . .	280
Washington,	5	100,000	168,800	3,606	33,500	717,650	275
Herkimer, .	5	35,000	106,237	2,296	33,500	269,912	128
Saratoga, .	4	144,000	270,000	5,752	. . .	1,210,660	460
Jefferson, .	3	170,000	327,000	6,020	22,600	1,004,720	595
Ulster, . .	3	140,000	410,000	5,796	330,000	115,000	475
Orange, . .	3	135,000	251,000	4,200	4,000	740,000	460
Madison, .	3	30,000	35,000	1,998	31,500	. . .	35
Tompkins, .	3	28,000	55,500	812	1,000	199,063	97
Onondaga, .	2	62,000	125,000	2,160	5,000	460,000	225
Monroe, . .	2	55,000	208,000	2,648	105,000	300,000	320
Clinton, .	2	16,000	25,000	884	. . .	100,000	70
Rockland, .	1	100,000	200,000	3,500	40,000	460,000	500
Schenectady, .	1	77,000	118,000	2,000	20,000	416,000	200
Chenango, .	1	75,000	200,000	4,474	. . .	800,000	225
Seneca, .	1	70,000	190,000	4,000	. . .	550,000	150
Cayuga, . .	1	70,000	180,000	2,692	8,000	180,000	138
Franklin, .	1	10,000	. . .	. . .	. . .	. . .	. . .
Suffolk, . .	1	10,000	36,000	576	33,000	. . .	30
Total, .	112	3,669,500	7,961,670	157,316	1,867,790	21,010,920	12,954

The number of persons employed in the cotton manufacture in the State of New York, according to the preceding Table, was 12,954; being more than three-fifths per cent. of the whole population, which at that period was estimated at upwards of two millions.

The valuation of property in that State, from the Comptroller's Report of January 1835, was as follows:—

Real Estate,	. . . . .	350,346,043 dollars.
Personal Estate,	. . . . .	108,331,941
Total,	. . . . .	458,677,984 dollars.

The capital invested in the cotton manufacture being 3,669,500 dollars, is nearly one per cent. on the valuation of the whole property of the State.

*STATEMENT of the Cotton Manufactures in 12 of the States  
in 1831.*

STATES.	Capital. Dollars.	Number of spindles.	Yards of Cloth produced yearly.	Pounds of Cloth produced yearly.	Pounds of Cot- ton consumed yearly.
Maine, . . . .	765,000	6,500	1,750,000	525,000	588,500
New Hampshire,	5,300,000	113,776	29,060,500	7,255,060	7,845,000
Vermont, . .	295,500	12,392	2,238,400	574,500	760,000
Massachusetts,	12,891,000	339,777	79,231,000	21,301,062	24,871,981
Rhode Island,	6,262,340	235,753	37,121,681	9,271,481	10,414,578
Connecticut, .	2,825,000	115,528	20,055,500	5,612,000	6,777,209
New York, . .	3,669,500	157,316	21,010,920	5,297,713	7,661,670
New Jersey, . .	2,027,644	62,979	5,133,776	1,877,418	5,832,204
Pennsylvania, .	3,758,500	120,810	21,332,467	4,207,192	7,111,174
Delaware, . .	384,500	24,806	5,203,746	1,201,500	1,435,000
Maryland, . . .	2,144,000	47,222	7,649,000	2,224,000	3,008,000
Virginia, . . .	290,000	9,844	675,000	168,000	1,152,000
Total, . . .	40,612,984	1,246,703	230,461,990	59,514,926	77,457,316

In the State of Pennsylvania there were 500,000 dollars, and in Delaware 162,000 dollars invested in hand looms, both of which sums are included in the amount specified in the preceding Table, as the capital invested in the cotton manufacture.

The preceding Table shows the extent of the cotton manufacture of the United States in 1831; since that time there has been a considerable increase. The amount of capital invested in manufactures in the State of Massachusetts was then 12,891,000 dollars; in 1836, it had increased to 14,369,719 dollars, being nearly 12 per cent. in the space of only five years; but allowing the ratio of increase since 1831 to be 10 per cent. all over the Union, the amount of capital now invested in the cotton manufacture cannot be less than forty-five millions of dollars, equal to £9,375,000 Sterling, being about a fourth part of the capital invested in the cotton manufacture of Great Britain.

The following Table contains the number of Mills, rate of weekly wages, and the number of hands employed in the Factories in 1831.

STATES.	Mills.	Looms.	Males employ'd	Average Wages of Males weekly.	Females employ'd	Average Wages of Females weekly.	Children under 12 employ'd	Average Wages of children.
			dols. cts.		dols. cts.		dols. cts.	
Maine, . . .	8	91	84	5 50	205	2 33		
New Hampshire,	40	3,530	875	6 25	4,090	2 60	60	2 0
Vermont, . .	17	352	102	5 0	363	1 84	19	1 40
Massachusetts, .	256	8,981	2,665	7 0	10,678	2 25		
Rhode Island,	116	5,773	1,731	4 25	3,297	2 20	3,472	1 50
Connecticut, .	94	2,669	1,399	4 50	2,477	2 20	439	1 50
New York, . .	112	3,653	1,374	6 0	3,652	1 90	484	1 40
New Jersey, .	51	815	2,151	6 0	3,070	1 90	217	1 40
Pennsylvania, .	67	6,301	6,545	6 0	8,351	2 0		
Delaware, . .	10	235	697	5 0	676	2 0		
Maryland, . . .	23	1,002	824	3 87	1,793	1 91		
Virginia, . . .	7	91	143	2 73	275	1 58		
Total, . . .	801	33,433	18,590		38,927		4,691	

The preceding tables show the particular distribution of the cotton manufacture in the United States, from which it will be seen that the greatest number of Factories and spindles employed are in the State of Massachusetts, next to it are Rhode Island and New York; but Rhode Island is a very small State compared with either of the other two, and in proportion to its extent may be said to contain more than three times the number of Cotton Factories in New York State. The cotton manufacture commenced in Massachusetts and Rhode Island, and ever since these two have continued the principal manufacturing States in the Union.

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#### LOWELL, (MASSACHUSETTS.)

THE principal manufacturing town in the United States is that of Lowell, which may justly be denominated the Manchester of America, as regards the amount of capital invested for manufacturing purposes, the extent of the business, and the spirited manner in which it is conducted. And here, too, the Factory system is perhaps in more perfect operation than in any other part of the United States. Here are the largest establishments, the most perfect arrangement, and the richest corporations. And it may, without fear of contradiction, be asserted, that the Factories at Lowell produce a *greater quantity of yarn and cloth from each spindle and loom (in a given time,) than is produced in any other Factories without exception in the world.*

The following short account of the introduction of the cotton manufacture into Lowell is quoted from the Lowell Journal, a spirited newspaper published weekly.

"The territory of Lowell is about four square miles, and contains upwards of fifteen thousand\* inhabitants. About eighteen years ago the whole of this was owned by a few honest farmers, who obtained subsistence for themselves and families by the cultivation of this comparatively barren spot; and the fish they caught in the Merrimack and Concord rivers. And being situated at the confluence of these two rivers, was called Chelmsford Neck, and originally by the Indians Wamaset.

"For centuries it lay with its vast resources slumbering in its bosom, unsuspected and unknown. But the spirit of improvement came, and its touch like that of the magic wand, has turned this seeming wilderness, not simply into a fruitful field, but into a busy, enterprising, and prosperous city.

"In 1819, Kirk Boot, Esq.,† a wealthy Merchant of Boston, explored this place in the habit of a hunter. He discovered its resources, and immediately, in

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\* This was the number of inhabitants at the time this article was written, but according to a late statement in the same paper it appears there are now 20,000.

† Mr Kirk Boot was a native of Boston, but received his early education in England: he spent one or two years at Harvard University, after which he joined the British army, and served some time as an officer under the Duke of Wellington in the Peninsular war; on his return from which, he spent some years at the Military School at Woolwich, in England, where he acquired considerable

company with several other rich merchants of that city, purchased the land and water privileges.

"They were incorporated by the name of the Proprietors of the Locks and Canals on Merrimack river, and commenced operations, by digging a Canal from the Pawtucket Falls, easterly, one mile and a half where it emptied itself into the Coneord river. This Canal is sixty feet wide, and carries in depth eight feet of water. This is their grand Canal; lateral branches are cut, which carry the water to the several manufactories, from which it is discharged into the Merrimack or Concord rivers. They then erected a large machine shop, and commenced building machinery. This company sell out the privileges

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proficiency as a draftsman and engineer. On his return to Boston, he engaged in mercantile pursuits, his mind being now withdrawn from the military, and directed to that of a commercial or mercantile life: he easily discovered the vast resources of the Merrimack, and the immense advantages that might be derived from employing its waters in propelling machinery; accordingly he found some wealthy merchants in Boston equally enterprising with himself, who willingly joined with him in purchasing the property on which the city of Lowell now stands. Mr Boot was appointed their agent, and superintended the cutting of the Canals, erecting the Factories, planning and building the whole city, in which situation his extraordinary talents for business rendered his services invaluable: during his superintendence, a large thriving city, containing nearly 20,000 inhabitants, was raised from a comparative wilderness. He died, April 11th, 1837, deeply regretted by a numerous circle of friends. He was a man of a generous public spirit, possessed of energy and enterprise sufficient for accomplishing great undertakings, while his gentlemanly manners and urbanity endeared him to his friends, his disinterested generosity and kindness gained for him the public respect.

to manufacturing companies, dig the Canals, erect the Mills, and build the machinery, all ready for being put in operation; they do all this cheaper than any other company will do it; and these are the only terms on which they will sell the privileges.

"The Locks and Canals Company have a capital of 600,000 dollars, employ about 500 workmen in the machine shop and otherwise. A part of their lands have been sold out to individuals at an enormous advance on the original price. Land for which they paid 20 or 30 dollars per acre, has been sold again for one dollar per square foot: there is still a portion of their land on hand unsold."—Kirk Boot, Esq., acted as their agent till his death in 1837.

"Lowell was incorporated in 1824 into a town distinct from Chelmsford, and received its name from Francis C. Lowell, Esq., who was amongst the first to introduce manufactures in this place. There are now twenty-seven Factories in operation, besides print works, bleacheries, &c. and there yet remain unoccupied privileges for nearly as many more: when these are taken up, as, in all probability, they will, they will then afford means of subsistence to another 20,000 inhabitants, making the whole about 40,000.

"A new Canal has been lately cut, which furnishes sites for about a dozen of Mills. A rail-road of two tracts has been completed between Boston and Lowell, which is found to be of mutual advantage to both places, but especially to the latter. There is also a steam boat plies between Nashua (another manufacturing place) and Lowell, a distance of fourteen miles, which likewise co-operates with the rail-road."

The total amount of capital invested for manufacturing purposes at Lowell, was, at the beginning of 1839, about 9,000,000 dollars, equal to £1,875,000 Sterling. There are ten incorporated companies, viz.

*1st*, Locks and Canals Co.—capital 600,000 dollars, = £125,000. This company originally owned the whole water power, which they sell out to the different manufacturing companies at the following rate. A Mill power is estimated at 3,584 throstle spindles, with the necessary machinery for preparing the cotton and manufacturing the yarn into cloth, and is sold for four dollars per spindle, = 14,336 dollars for the whole Mill power, together with about four acres of land surrounding the site of the Mill, for the Mill court and other necessary buildings. This company has a large machine shop for making machinery for the cotton and woollen manufactures, rail-road cars, engines, &c. They employ in general upwards of 500 hands; when building Mills they employ directly and indirectly from 1,000 to 1,200.

*2d*, The Merrimack Co.—capital 2,000,000 dollars, = £416,666 . 13 . 4. This company have five large Cotton Mills, besides print works. They run 37,984 throstle spindles, 1,300 looms, and give employment to 1,300 females, and 437 males; they make upon an average 220,000 yards of cloth per week, and use about 50,000 lbs. of cotton in the same time. They generally spin No. 22's and 40's yarn for making printed goods and sheetings.

*3d*, The Hamilton Co.—capital 1,000,000 dollars, = £208,333 . 6 . 8. This company have a large printing establishment, and three Cotton Mills.

They run 20,992 throstle spindles 564 looms, and give employment to 830 females and 230 males: they make about 100,000 yards of cloth, and use about 40,000 lbs. of cotton weekly: they generally spin No. 14's to 40's yarn for making drilling (three leaf tweel) printed and coloured goods.

*4th,* The Appleton Co.—capital 500,000 dollars, = £104,166 . 13 . 4. This company have two Cotton Mills, and run about 11,776 throstle spindles, 380 looms, and give employment to 470 females and 65 males. They make about 100,000 yards of cloth, and use 40,000 lbs. of cotton weekly; they generally spin No. 14's yarn for making shirtings and sheetings.

*5th,* The Lowell Co.—capital 500,000 dollars, = £104,166 . 13 . 4. This company have one Cotton and one Carpet Factory contained in one building, but divided in the middle. They run 5,000 throstle spindles besides those used in the woollen manufacture; 154 cotton and 70 carpet looms; and give employment to 400 females, and 200 males. They make about 2,500 yards of carpeting, 150 rugs, and 60,000 yards of cotton cloth per week: they spin No. 12's yarn for making coarse negro cloth.

*6th,* The Suffolk Co.—capital 600,000 dollars, = £125,000. This company have two Cotton Mills, and run 11,264 throstle spindles, 352 looms, and give employment to 460 females, and 70 males. They make about 90,000 yards of cloth, and use about 32,000 lbs. of cotton weekly; they spin No. 14's yarn for drillings.

*7th,* The Tremont Co.—capital 600,000 dol-

lars, = £125,000. This company have two Mills, and run about 11,520 throstle spindles, 404 looms, and give employment to 460 females, and 70 males. They make about 125,800 yards of cloth, and use 34,000 lbs. of cotton weekly: they generally spin No. 14's yarn, for making shirtings and sheetings.

*8th,* The Lawrence Co.—capital 1,500,000 dollars, = £312,500. This company have five extensive Factories and a Bleachery; they run 31,000 throstle spindles, 910 looms, and give employment to 1,250 females, and 200 males. They make about 200,000 yards of cloth, and use about 64,000 lbs. of cotton weekly: they spin No. 14's to 30's yarn for making printed cloth, shirtings and sheetings.

*9th,* The Middlesex Co.—capital 500,000 dollars, = £250,000. This company manufacture broad cloths, cassimeres, &c. They have two Mills and a dye-house, and give employment to 350 females, and 185 males: they run about 4,620 spindles, 38 broad cloth, and 92 cassimere looms. They make about 6,300 yards of cassimere and 1,500 yards broad cloth weekly. They use 600,000 lbs. of wool, and 3,000,000 teasels yearly.

*10th,* The Boot Cotton Mills Co.—capital 1,200,000 dollars, = £250,000. This company have four large elegant Factories in operation, containing 29,248 throstle spindles, and 830 looms. They employ upwards of 950 females, and 120 males, and produce upwards of 155,000 yards of cloth, and consume 53,300 lbs. of cotton weekly. They spin from No. 14's to 50's yarn for making drillings, shirtings, and cloth for printing. This

company spin the finest yarn on the dead spindle throstle of any that I am aware of in this country.

To the above-named principal establishments may be added, the extensive Powder Mills of O. M. Whipple, Esq.; the Lowell Bleachery; Flannell Mills; Card and Whip Factory; Planing Machine; Reed Machine; Flour, Grist and Saw Mills, together employing above 300 hands, and a capital of 300,000 dollars, = £62,500; and in the immediate vicinity of Lowell, there are Glass Works, and a Foundry supplying every description of castings.

The Locks and Canals Co.'s Machine Shop can furnish complete machinery for a Mill containing 5,000 throstle spindles with weaving in proportion, in four months, having lumber and materials always at command, to build or re-build a Mill in that time if required.

The following Table contains a more condensed view of the Lowell manufactures. It was compiled at the beginning of 1839 from the most authentic sources, and may be relied on for its accuracy. It may be proper to remark, however, that Lowell is not yet finished, but is still extending in wealth and population; nor can we conceive the extent to which it may yet be enlarged, as it is the opinion of many that there are still a sufficiency of power to propel double the machinery already in operation: at present it is the most important and extensive manufacturing town in the United States, and in all probability will continue to be so.

STATISTICS of LOWELL MANUFACTURES, 1st January, 1839.—Compiled from authentic sources.

Kinds of Goods made, .....	Machinery, Printers and engines, car shadings, &c. for rail. No. 22 to 40, roads.	Prints and Drawings, No. 14 to 40.	Sheetings & stirrings, No. 14.	Carpets, Rugs, Dril-ling, & Negro cloths No. 14 to 40.	Drillings, No. 14.	Sheetings & Shirtings, No. 14 to 30.	Printing Cloth, Dril-ling, and Shirtings, No. 14 to 30.	Broad cloth, & Casimere, No. 14 to 30.	Printing cloth, Dril-ling, and Shirtings, No. 14 to 30.
Tons Anthracite coals used per year	5,200	2,800	400	400	330	650	500	750	11,360
Chaldron smiths' coal,	200	•	•	•	•	•	•	•	200
Tons hard coal, .....	200	•	•	•	•	•	•	•	200
Cords of wood used per year,	300	570	1,250	•	500	70	60	1,000	3,880
Gallons of oil used per year, .....	2,300	8,700	6,500	3,440	Olive, 4000 Sperm, 4000	3,692	8,217	Olive, 11,000 Sperm, 2,500	65,289
Diameter of water wheels, .....	13	30	13	13	13	13	13	17	17 & 12
Length of water wheels,	14	24	42	14	60	42	42	60	46 & 21
When incorporated	1792	1822	1825	1828	1828	1830	1830	1830	1835
Commenced operations, .....	1822	1823	1825	1828	1828	1832	1832-4	1830	1836
How warmed,.....	Hot air furnace.	Steam & Hot air.	Hot air furnace.	Hot air furnace.	Hot air furnace.	Steam.	Hot air furnace.	Wakefield furnace and Steam.	Steam & Hot air.

Cotton consumed at Lowell per annum, (say one half Uplands, and one half New Orleans and Alabama,) . . . 18,059,600 lbs.

Cloth manufactured at Lowell per annum, . . . 55,185,000 yds. being rather more than 3 yards from each pound of Cotton.

One hundred pounds of Cotton will produce eighty-nine pounds of Cloth.

Average wages of females at Lowell, 2 dollars per week, besides their board.

Average wages of males, 80 cents. or 3/4 per day, besides their board.

As regards the health of persons employed, great numbers have been interrogated, and the result shows that six females out of every ten enjoy better health than before being employed in the Mills,— of males one half derive the same advantage: as regards their moral condition, they are not inferior to any portion of the community.

Medium produce of each loom at Lowell, on No. 14's, 44 to 55 yards per day.

Medium produce of each loom at Lowell, on No. 30's, 30 yards per day.

Average produce per spindle, . . . .  $1\frac{1}{10}$  yds. of cloth per day.

Average amount of wages paid per month, 145,000 dollars, = £22,083 . 6 . 8.

Consumption of Starch per annum, . . . . . 600,000 lbs.  
of Flour for Starch in the Mills, Print

Works and Bleachery per annum, . . . . . 3,800 bar.

Consumption of Charcoal per annum, . . . . . 500,000 bu.

*Hours of labour at the Lowell Factories.*

From the first of September to the first of May, work is commenced in the morning as soon as the hands can see to advantage, and stopped regularly during these eight months, at half-past seven o'clock in the evening.

During four of these eight months, viz. from the first of November to the first of March, the hands take breakfast before sunrise, that they may be ready to begin work as soon as they can see: but from the first of April till the first of October, 30 minutes are allowed for breakfast at seven o'clock, and during the months of March and October at half-past seven.

During the four summer months, or from the first of May to the first of September, work is commenced at five o'clock in the morning, and stopped at seven in the evening.

The dinner hour is at half-past twelve o'clock throughout the year; the time allowed is 45 minutes during the four summer months, and 30 minutes during the other eight.

The following Table of the average hours of labour, has been furnished me by an experienced manufacturer, and is deemed as correct an average as could be given.—The time given is for the first of each month.

*Average hours of work per day throughout the year.*

	Ho.	Min.		Ho.	Min.
January, . . . .	11	24	July, . . . .	12	45
February, . . . .	12	„	August, . . . .	12	45
March, . . . .	11	52*	September, . . .	12	23
April, . . . .	13	31	October, . . . .	12	10
May, . . . .	12	45	November, . . .	11	56
June, . . . .	12	45	December, . . .	11	24

Taking one day for each month, the whole number of working hours in the year, according to the preceding Table, are 146 hours 44 minutes, which, divided by twelve for the number of months, gives a result of 12 hours 13 minutes as the average time for each day, or 73 hours 18 minutes per week; therefore about  $73\frac{1}{2}$  hours per week may be regarded as the average hours of labour in the Cotton Factories at Lowell, and generally throughout the whole of the Eastern District of the United States. In many, perhaps in the majority of the Cotton Factories in the Middle and Southern Districts, the hours of labour in summer are from sunrise to sunset; or from half-past four o'clock in the morning, till half-past seven in the evening; being about  $13\frac{3}{4}$  hours per day, equal to  $82\frac{1}{2}$  hours per week. In these Factories the average hours of labour throughout the year will be about  $75\frac{1}{2}$  per week.

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\* The hours of labour on the first of March are less than in February, even though the days are a little longer, because 30 minutes are allowed for breakfast from the first of March to the first of September.

As the days in this country are shorter in summer, and longer in winter, than in Britain, the following Table is given to show the time of the sun's rising and setting on the first and fifteenth days of each month in the year. It is compiled from the American Almanack, and adapted to the latitude of Boston, viz.  $42^{\circ} 20' 23''$  North.

	Sun rises.	Sun sets.	Length of day.
	H. M.	H. M.	H. M.
January 1.	7 30	4 38	9 8
Do. 15.	7 28	4 51	9 23
February 1.	7 14	5 14	10 "
Do. 15.	6 57	5 32	10 35
March 1.	6 35	5 50	11 15
Do. 15.	6 12	6 7	11 55
April 1.	5 43	6 26	12 43
Do. 15.	5 19	6 40	13 21
May 1.	4 54	6 59	14 5
Do. 15.	4 39	7 18	14 39
June 1.	4 25	7 29	15 4
Do. 15.	4 22	7 38	15 16
July 1.	4 26	7 40	15 14
Do. 15.	4 36	7 35	14 59
August 1.	4 52	7 20	14 28
Do. 15.	5 6	7 2	13 56
Septem. 1.	5 26	6 35	13 9
Do. 15.	5 39	6 12	12 33
October 1.	5 56	5 43	11 47
Do. 15.	6 12	5 20	11 8
Novem. 1.	6 33	4 55	10 22
Do. 15.	6 51	4 39	9 48
Decem. 1.	7 10	4 29	9 19
Do. 15.	7 23	4 28	9 5

Lowell being the largest and most important manufacturing town in the United States, I have

carefully collected the most authentic and general statistical information regarding it, as the rate of wages, and other regulations established at this place, will always have a considerable influence on other manufacturing establishments in America. The notice taken of other manufacturing places will be more brief.

As much vague and contradictory information has been circulated in Great Britain regarding the hours of labour in the American Factories, I have endeavoured to give as accurately as possible, both the average hours per week for the year, and the length of working hours at the different seasons. From the preceding statements, it will be seen that the average hours per week throughout the year, are  $73\frac{1}{2}$  in the Eastern, and part of the Middle and Southern Districts, and  $75\frac{1}{2}$  in a considerable number, probably four-fifths of the Factories in the Middle and Southern Districts.

In Great Britain the hours of labour per week are limited by Act of Parliament to 69, or  $11\frac{1}{2}$  hours per day, but the general regulation in all the Factories is 9 hours on Saturday, and 12 hours on each of the other five days. It is also enacted, that there shall be six holidays in the course of the year. In the United States, there are only three holidays in the year. The first is called a general fast, and is entirely devoted to religious exercises. It is generally kept about the middle, or the 20th of April, being about the time the battle of Lexington was fought, near Boston, when the first blood was shed by the Americans in the cause of Independence. The second holiday is the 4th of July, called

Independence Day, and is wholly devoted to public rejoicings, being an anniversary intended to commemorate the memorable Declaration of Independence, published at Washington on the 4th of July 1776, by the representatives of the then thirteen confederated colonies. The third holiday is generally about the 1st or 2d of December, and denominated Thanksgiving-day. It is partly devoted to religious exercises in the morning, and social intercourse in the afternoon. Upon this day, the scattered members of each family endeavour to meet at what may be called their home, for the purpose of enjoying the social company of each other, and gratifying their filial attachments.

In this country the time for breakfast is seven o'clock, and for dinner half-past twelve: supper at seven, or half-past seven in the evening. In Scotland the Mills begin work at six o'clock in the morning throughout the year, and stop at nine o'clock for breakfast, and at two o'clock for dinner, 45 minutes being allowed for each. In England the Mills begin work in the morning at six o'clock, and stop at eight o'clock for breakfast, and twelve for dinner, and four o'clock in the afternoon for tea. Those that do not stop for tea, allow the workers to have it carried into the Mill at four o'clock. Thirty minutes are allowed for breakfast, and an hour for dinner. Thus each country has its own peculiar regulations, and each will no doubt prefer their own; but certainly for three meals a day, the Scotch proportion their time better than the others.

## RHODE ISLAND.

THERE are no manufacturing towns in this State equal to Lowell, yet there are a great number of manufacturing villages, and in proportion to its extent, this State contains a much greater number of Factories than that of Massachusetts.

The following notices of the various manufacturing districts in this State are chiefly compiled from White's Memoir of Slater. The first which claims attention, is that of

## NORTH PROVIDENCE.

THIS place was incorporated in 1767, and is now distinguished for its manufactures. There are ten Cotton Mills, one of which is the first that was built in America; and in Pawtucket, S. Slater erected the first water-frame spinning machinery. The extent of this business having concentrated a large capital, and an immense aggregate of industry has, within the last thirty years, given rise to this large flourishing village, which is situated on the North-East section of the town, four miles North-East of Providence, on the border of the Seekonk river, which affords numerous natural sites for manufacturing establishments of almost every description. The rapid march of manufacturing and mechanical industry which the short annals of this place disclose, has few examples in this country. The village is built on both sides of the river, which, at this place, divides Rhode Island from Massachusetts. That part of it which is in Rhode Island, is principally built on four streets, and comprises eighty-three dwelling-houses, and twelve mercantile stores. There are

six shops engaged in the manufacture of machinery, having the advantage of water power ; and various other mechanical establishments, affording extensive employment, and supporting a dense population. Upon the Massachusetts side of the river, the village is of nearly equal extent. Besides the Cotton Factories, there are in the town two Furnaces for casting, one Slitting Mill, two Anchor Shops, Screw Manufactories, Nail Factory, Flour Mills, and Machine Manufactories : here some very superior machinery is made, and sent to various parts of the country.

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#### SMITHFIELD.

AT this place there are nine Cotton Factories, all of which contain more than 11,000 spindles, one half of which belong to Slaters & Co., whose establishment is situated on a branch of the Pawtucket river, about one mile and a half from its junction. At this place there is a large and flourishing village, called Slaterville, which is but of recent date, having grown up with the cotton manufacturing business.

There is also a large establishment, containing 8000 spindles, owned by Butler, Wheaton & Co. of Providence. •

There are twenty public schools in Smithfield, and several private ones, three incorporated academies, four social libraries, and four places of worship.

## WOONSOCKET FALLS.

UPON the Pawtucket river there is a fall of water called Woonsocket Falls, which is considered a great curiosity. The fall is about 20 feet, not perpendicular, but over a precipice of rocks for some distance. The fall of the water upon these rocks through a succession of ages, has occasioned numerous excavations, all of which are smooth and circular, and some of them very large, being sufficient to contain several hogsheads.

A writer in the New York Transcript, quoted by Mr White, says,—This is a delightful town. It is the “bordershire” of the State, and joins the county of Worcester, one of the richest, most healthful, and enterprising sections of country to be found on the face of the globe. The town of Smithfield, for many years, had devoted itself exclusively to agricultural pursuits ; but of late years, has become the very focus of American industry. The Blackstone river and canal runs through it, and the almost endless variety of scenery with which it abounds, gives it many advantages over the ordinary inland towns of New England. It largely participates in the industry of the day, and probably operates a greater number of spindles than any town or village this side of the Potomac.

The village of Woonsocket, which may be denominated the capital of Smithfield, is at the fall of the Blackstone river, and drives a very heavy, as well as profitable business. It is said that there are upwards of 50,000 spindles in operation at this place, besides an immense quantity of other machinery.

The village partakes of all the variety of pastoral beauty, and its cliffs, and waterfalls, and bubbling streams, are pre-eminently calculated to give inspiration to the poet.

The Mill sites at Woonsocket are very valuable, and it is said they could not be purchased for half a million of dollars. The village and most of its dependencies belong to capitalists of Providence.

**DOUGLAS.**—At this town, on the Mumford river, the Douglas Manufacturing Co. have two Mills, both five stories in height. They have in operation 4,000 spindles, 119 looms, and employ about 200 hands: the cloth manufactured is generally for printed goods.

**SLATERVILLE** embraces a part of Douglas and a part of Dudley. This place derived its name from Samuel Slater, who generally resided here, and here he had several Mills, (said to be seven in all,) part of which derive their power from French River, and part from a large pond called Slater's Lake, about four miles long, which is a never-failing source of supply.

Besides the above-named villages, there are many others of equal, and some of greater extent and importance, in various parts of the State, such as Cranston, Warwick, Scituate, New-Port, Lonsdale, Coventry, Cumberland, Johnston, &c. At New-Port, there are four Cotton Factories all moved by Steam. There is also a large Steam Mill at Providence, owned by the heirs of Samuel Slater. At Lonsdale, there are three elegant Factories, and here, too, Nankeens are manufactured from cotton of a very deep dirty cream colour, a small quantity

of which is raised annually in Georgia of an inferior quality.

Passing from Rhode Island into the State of Connecticut, the traveller is greatly delighted with the site of a number of beautiful and handsome manufacturing villages. Indeed, this State is famed for its neat villages and beautiful landscapes.

"The pleasant village of Cabotsville," says Mr White, "has grown up with astonishing rapidity, and bids fair to become, at no very distant day, a second Lowell."

"The water power at this place is immense, and as yet scarcely begun to be occupied. There is a neatness, too, and good taste, in the location of the streets, and the arrangement of the buildings, which is not common in manufacturing villages. The Cotton Factories are extensive, and in appearance resembling those at Lowell."

Another flourishing village in this State, called Williamantic, is situated in Windham county, on the Williamantic river, near its confluence with another small river called the Natchang. It extends about a mile along the former stream. Twelve years ago there were less than a dozen houses, and those very indifferent ones, on the site of the present village. Now there are four manufacturing establishments, containing 12,800 spindles, and making annually about 2,915,000 yards of cotton cloth. There is also a Paper Mill and a small Sattinet Factory. The village, as well as the surrounding country, seems to be prospering, and advancing in moral and intellectual improvement. It contains three places of public worship, two free, and three private schools, and a public library.

Greeneville is another beautiful village, situated on the West bank of Shetucket river, a little below its junction with the Quinebaug, and five hundred rods above steam and packet navigation. This village has had almost as rapid a growth as the villages of the West. The General Assembly of Connecticut granted a charter in 1828, to a Company under the name of the "Norwich Water Power Company," the object of which was the construction of works to bring into use the immense water power at this place, then wholly unoccupied. The capital of the Company was 40,000 dollars; and having purchased a large tract of land lying on both sides of the river, they proceeded to erect a dam, and dig a canal, through which the water of the river necessary for manufacturing purposes might flow. The dam is built of stone, in length 280 feet, and is both solid and substantial, so that there is little reason to apprehend that it will be carried away, although the river is subject to great annual freshets. The abutments are very handsome and durable specimens of stone masonry. The canal is about a mile in length, forty-six feet wide at the surface, and ten feet deep. These works were completed in 1830.

There are several manufacturing establishments at this place, the largest of which is that of the Thames Company, for the manufacture of cotton cloth. This is one of the finest edifices of the kind in New England, being built of brick, five stories high, 138 feet in length by 44 in width. There are employed in it about 180 persons of different ages and sexes, and about 42,000 lbs. of cotton are consumed monthly, while, in the same space of time, about 132,000 yards of cloth are produced.

The Shetucket Factory for the manufacture of bed ticking, contains 1,650 spindles, employs about 70 persons, and consumes about 14,000 lbs. of cotton, producing about 28,000 yards of cloth per month.

The Greeneville Manufacturing Company employ about 50 persons, and produce about 12,000 yards of flannel monthly, using for that purpose about 4,800 lbs. of wool.

There are also two Carpet Factories, a Paper Manufactory, a Machine Shop, and other small Factories at this place, which is still increasing. A number of very eligible sites for Manufactories are yet unoccupied, and a large amount of water power unemployed.

The village is situated in a delightful tract of country. The dwellings are very neat and attractive, being all painted white; they have a uniform and handsome appearance, and seem to be the abode of industry and contentment.

There are various other manufacturing villages about this part of the Union, of which I have not as yet been able to obtain any correct information. A vast number of small Factories and manufacturing villages are scattered over the State of New York, which I have not yet had the opportunity of visiting, neither have I been able to obtain any written account of them.

## PATERSON, NEW JERSEY.

THIS town, next to Lowell, is one of the greatest manufacturing towns in America. The Mills here are not so large and splendid, nor is the business conducted with the same life and spirit as at Lowell ; yet there are some very superior goods manufactured, and machinery made, at this place, in every respect equal, and some of it superior to any thing of the kind made at the other.

The cotton manufacture commenced at Paterson at a very early period. A society was formed in the early part of 1791, denominated "The Society for the Establishment of Useful Manufactures;" the immediate object of which was the manufacture of cotton cloths. At this period no cotton had been spun by machinery in America, except at Pawtucket in Rhode Island. The number of shares originally subscribed was 5000 at 100 dollars a share, but 2267 shares only were fully paid up. It was ascertained by this Society, that the Great Falls of the Passaic river in New Jersey, had an elevation of 104 feet above tide water, and were calculated to be capable, by their elevation and volume of water, of driving 247 undershot water wheels. And at Little Falls, four miles higher up, a thirty-six feet Fall was deemed capable of driving 78 water wheels. Becoming thus satisfied, from various sources of information, regarding the superiority of this situation, they selected the Passaic as the principal site of their proposed operations, and gave to the town the name of Paterson after the Governor of New Jersey, who

signed their charter, vesting them with power over, and possession of, the waters of the Passaic river at this place. The Society, soon after the grant of its charter and purchase of the ground, proceeded to establish their first Cotton Factory and printing house ; which were attended however with considerable loss. They invited and encouraged skill by leasing privileges and aiding manufacturers with capital. This was well calculated to induce numbers to come and share in the advantages of the vast water power. Experienced Mill owners from various parts came hither, bringing wealth even from England ; artisans of various descriptions from Britain, were invited and encouraged to settle in the place. A race-way and canal was commenced by the direction of the Company, designed to unite the Upper Passaic with the Lower, at the head of tide, near the present village of Acquackanonck ; the engineer to whom the execution of this work was committed, spent vast sums of money to little purpose: latterly, a Mr Colt from Connecticut, was appointed superintendent of the affairs of the Company, with full powers to manage the concerns of the Society : he completed the race-way, but the canal to tide was abandoned. The first Factory, 90 feet long by 40 wide, and four stories high, was finished in 1794, when cotton yarn was spun in the Mill ; but yarn had been spun the preceding year by machinery moved with oxen. Calico shawls and other cotton goods, were printed the same year ; the bleached and unbleached muslins being purchased in New York. But the concerns of the Company became involved in difficulty ; yet they persevered in their

enterprise, and in the years 1795 and 1796, much yarn of various sizes was spun, and several pieces of cotton goods manufactured. At length, however, they were forced to abandon the manufacture, and discharge their workmen. This result was produced by a combination of causes. Nearly 50,000 dollars had been lost by the failure of parties, to certain bills of exchange purchased by the Company, to buy in England plain cloths for printing: large sums had been wasted by the engineer and the machinists, and the manufacturers brought from other countries, were presumptuous and ignorant of many branches of the business they engaged to conduct; the Company was inexperienced in the business, and the country unprepared for manufactures. The Cotton Mill belonging to the Company was subsequently leased to individuals, who continued to spin candle-wick and coarse yarn, until 1807, when it was accidentally burned, and never rebuilt.

The water power of the Company, however, was not wholly unemployed. In 1801, a Mill site was leased to Messrs. Kinsey & Co.; in 1807, a second; and in 1811, a third to other persons; between 1812 and 1814, several others were sold or leased. In 1814, Mr Colt purchased, at a depreciated price, a large proportion of the shares, and re-animated the association. From this date the growth of Paterson has been steady, except during the three or four years that followed the peace of 1815. The advantages derivable from the great fall in the river, have been improved; a dam of four and a half feet high, strongly framed and bolted to the rock, in the bed of the river above the falls, turns the stream through

a canal excavated in the trap rock of the bank, into a basin, whence, through strong guard-gates, it supplies in succession, three canals on separate plains, each below the other, giving to the Mills on each head, a fall of about 22 feet. By means of the guard-gate the volume of water is regulated at pleasure, and a uniform height preserved, avoiding the inconvenience of back water. 40,000 dollars have been expended to complete this privilege.

When the Company first commenced operations, there were not more than ten houses at Paterson. In 1827 there were 6,236 inhabitants; 1,046 heads of families; 7 houses for public worship; 17 Schools; a Philosophical Society; 15 Cotton Factories, in which 24,000 spindles operate; 2 Factories of canvas; 1,644 spindles, employing 1,453 persons, whose wages are 224,123 dollars a year; extensive Machine Shops and Iron Works; there were 620,000 lbs. of flax; 6,000 bales of cotton consumed annually, and 1,630,000 lbs. of cotton yarn; 430,000 lbs. of linen yarn spun in the same time; besides 630,000 yards of linen and duck; 3,354,500 yards of cotton cloth; and at that time, new Factories were still being built.

The cotton manufacture is carried on to some extent near to Philadelphia, but I have not been able to obtain correct information regarding the number or extent of the Factories, either at this place or Baltimore. Cotton Factories are also extending rapidly in various parts of the Southern States, in Virginia, North Carolina, Tenesse, and in towns along the Ohio. "At a fine water privilege in Athens, Georgia, there was established a

Cotton Mill, with machinery from England, by Dearing & Co.; it is still in operation, and one also in Columbus." The time, indeed, seems to be fast approaching, when Cotton Factories will be established at the South, the North, East, and far West of America. And there can be no doubt but this country is destined, at no very remote period, to be the great emporium of the cotton manufacture of the world, as it possesses all the necessary requisites for that purpose, viz. extensive available water power, an intelligent and enterprising population, and having within itself an abundant supply of the raw material. Those Factories established in the South, must possess decided advantages over all others, as the manufacturers there will also be the cultivators of their own cotton, which may be brought from the fields where it is raised, to store-houses connected with the Factory in which it is to be cleaned and spun into yarn, and thereby all the expenses of baling and transporting saved. And if the experiment of slave labour succeed in the Factories, as is confidently expected, the cost of manufacturing the cotton into cloth, will be much less there than anywhere else; so that it will not be surprising if, in the course of a few years, those Southern Factories should manufacture coarse cotton goods, and sell them in the public markets at one half the price at which they can be manufactured in England. There are several Cotton Factories in Tennessee operated entirely by slave labour, there not being a white man in the Mill but the Superintendent; and according to a letter lately received from the Superintendent of one of these Factories, it appears that the blacks

do their work in every respect as well as could be expected from the whites.

"Cotton Factories are rapidly springing up in North Carolina; but with two or three exceptions they are chiefly employed only in spinning cotton yarn. The two oldest Factories in this State are one at the Falls of Tar River in Edgecombe county, established in 1818; and another near Lincolnton, in 1822. Factories have since been established at Mocksville, Greinsborough, Faetteville, Lexington, Salem, Milton, and in the counties of Orange and Randolph; there are eleven Factories in all. Arrangements are in progress for establishing similar works in various other parts of the State."

"Cincinnati," says Mr White, "is the great commercial emporium of Ohio, and, next to New Orleans, the largest city in the valley of the Mississippi. The value of its manufactures is about 2,500,000 dollars annually. There are ten foundries, including a brass and bell foundry, and one for casting types. There are four Cotton Factories, fifteen Rolling Mills, Steam Engine Factories and Shops, three Breweries, Button Factory, Steam Coopering Establishment, five or six Saw Mills, two Flour Mills, and one Chemical Laboratory. There are not less than forty different Manufacturing Establishments driven by steam power."

A writer quoted by Mr White, visited the Cotton Works of one company situated at Matoaca, on the North bank of the Appomattox, about four miles from Petersburg, and "was no less gratified by the beauty and substantial appearance of the buildings, than surprised at the expedition with which they

have been erected." The works here referred to consist of two Cotton Mills, three stories high; a Machine Shop and Sizing House, built of granite of a superior quality, obtained from a quarry on the Company's land. The principal Mill is 118 feet long by 44 wide; the other 90 feet long by 40 wide. They contain about 4000 spindles, and 170 looms.

"The manufactures of Virginia, like her coal mines, are just beginning to rise into importance. But recently the attention of her citizens has been directed to the subject, and few out of the State are aware how far she has already advanced, and how rapidly she continues to advance in this branch of industry."

In Richmond and Manchester, Virginia, there are in full operation two Cotton Factories, and three Iron Foundries, to one of which a Steam Engine Manufactory is attached. There are also a number of other Establishments, and few places can boast of such large or superior Flour Mills. The Galego Mill, which is, perhaps, the largest in the world, runs 22 pairs of stones, and makes 500 barrels of flour daily. Haxal's Mill is but little inferior to this, and Rutherford's and Clark's, though less than the others, are considerable Mills.

"The water power at and near Richmond, is immense, and easily available; it is the entire James River, which is nearly half a mile wide, and falls more than a hundred feet in a few miles. The advantages of its position are many and great; situated at the head of good navigation,—open nearly all the year,—adjacent to a rich coal field,—connected with the interior, as it soon will be, by a canal leading through a fine iron district,—with a healthy and

pleasant climate, surrounded by a good soil, nothing can prevent its becoming one of the greatest manufacturing cities in the Union.

" Next to Richmond in importance, and in some respects in advance of it, is Petersburgh, at the head of the tide water of the Appomattox. Here Cotton Factories grow up and flourish as if by magic; there are now five or six all in full operation, and all of them extensive establishments. One of them, a short distance from Petersburgh, is inferior to few, if any, in the Northern States, and with the houses built for the workmen, forms quite a village. All these Manufactories employ white labourers. The experiment, however, of negro or slave labour, has been made in one of the Factories at Richmond, and has proved fully successful. Other Manufactories are about to be erected near Petersburgh, in some of which it is expected that negro labour will be introduced generally, if not exclusively. Indeed, there is every reason to believe that it is better adapted to the manufactory than to the field, and that the negro character is susceptible of a high degree of manufacturing cultivation. Should this kind of labour be found to succeed, of which I think from some years acquaintance with it, there can be no doubt, it will give a decided advantage to the Southern over the Northern or European manufacturer. This kind of labour will be much cheaper, and far more certain and controllable. The manufacturer will have nothing to do with strikes, or other interruptions that frequently produce serious delay and loss to the employer. Before the present year, [1835,] the average expense for a good negro

man per year, might be estimated at 100 dollars, = £20 . 16 . 8 for field labour. Some superior hands, well acquainted with tobacco manufacturing, or good mechanics would, perhaps, go to 150 dollars ; these prices include hire, food, clothing, &c. They are now, in consequence of the great demand for labourers on the rail-roads, at least 20 dollars higher ; that is, about 170 dollars, = £35 . 8 . 4 for a good negro man for a whole year ; of course, females and young men will be much cheaper.

“ The water power of Petersburgh, though inferior to that of Richmond, is yet very considerable. It is also without the advantages of an immediate connection with the coal and iron regions ; nor has it so good a navigation as the latter, as vessels only of six feet draught of water can come to it, while those drawing eleven may go to Richmond. Yet Petersburgh is as well, if not better situated for the cotton manufacture, than Richmond. A rail-road of sixty miles in length connects it with the Roanoke, and brings to it daily large quantities of cotton, from which it can have the first and best selections. This, together with the cheapness of water power, building materials, and all other articles that enter into the consumption of those who labour, give to it great advantages.

“ Besides these two prominent places, many others might be found in Eastern Virginia, Georgia, Carolina, Tennessee, &c. equally favourably situated for Manufactories. At Fredricksburgh, on the Rappahannock, is a considerable water power, and on nearly all the rivers that empty into the Chesapeake, there are more or less sites. On the James

River, between Richmond and the mountains, they are almost innumerable; and when the State improvements are completed, they will be in good location.

"Manufacturing is carried on at Wheeling on the Ohio, but Western Virginia is identified with the great valley of the Mississippi; the future greatness or prosperity of which, no imagination can reach; it is a world in itself, and the world beyond it cannot change its destinies."

From the above extracts, it appears that the Southern States possess many facilities for extending the cotton manufacture, such as cheap labour, materials, &c. with an abundant water power, land and water carriage, &c. However, although the manufacturers in the Northern States cannot provide the raw material so cheap as those in the Southern, they have the advantage of the manufacture being already established, with mechanics and artizans of every description intimately acquainted with the business in all its details. The standing which the cotton manufacture has acquired in the North, and the uncongenial nature of the Southern climate, render it a matter of doubt to many, whether the South will ever outrival the North in this business.

At present the Northern States are still progressing in the manufacture of cotton goods; the greater part of which, however, has hitherto been made for home consumption. A considerable quantity, however, has been exported to South America and India, in both of which markets it has been ascertained, that the American manufacturers were able to com-

pete successfully with the British. At present, the attention of manufacturers in this country, is particularly directed to exporting cotton yarn in the bundle; and should this business succeed, I have no doubt but the British will find them rather formidable rivals, as whatever yarns may be exported from this country will, (like the cloth,) maintain its character in any market where it may be sold, and this, I know, is not always the case with much that is exported from Great Britain.

There is yet much unoccupied water privilege in the Northern States. A dam has lately been completed across the Kennebec River, in the State of Maine, by means of which the whole of the water of that river may be directed into canals, and thereby furnish valuable sites for, it is said, nearly one hundred Cotton Factories. At Brunswick, in the same State, there is abundance of unemployed water power, where one Factory has lately been put in operation, and others are expected soon. At Saco there are three Mills in operation, and sufficient water power for ten more. At Amoskeag, about 40 miles from Lowell, a canal is just now being cut, which, it is said, may take in the whole of the Merrimack River, and supply water power for upwards of fifty Factories. But instead of availing themselves of these water privileges, the attention of manufacturers has been for some time directed to the advantages of steam, as a means of propelling machinery; the advantages of a good location being considered equal to the extra expense of steam power. Mills propelled by steam may be situated in seaport towns, where there will be no expense

for land carriage, and being in a thickly populated neighbourhood, are likely to have generally a good supply of helps; whereas those driven by water, are subject to interruptions in winter, in consequence of the canals freezing up, and a deficiency of water in the drought of summer, besides the expense of land carriage ; although the latter, no doubt, depends upon the location of the Mills.

Three large Mills driven by steam are in operation at Newburyport in Massachusetts, and another is soon to be erected ; it is likewise probable that so soon as coals become a little cheaper, there will be a number of Mills with steam power erected in various parts of the country.

There are several manufacturing towns and villages to the Eastward of Massachusetts which are worthy of a passing notice before leaving this part of the subject. In New Hampshire there are New Market, Dover, and Great Falls, at each of which there are extensive Manufactories. At New Market there are three large Cotton Factories, in which goods of a very superior quality are manufactured, chiefly shirtings and sheetings. These works bear a very high character, and it is said, they have always been well conducted, and have paid the proprietors a very handsome profit, at least until the depression of 1837.

At Dover there are also three large and respectable Cotton Factories, situated so as to form three sides of a solid square, the fourth side being entirely occupied as a printing establishment; and this, together with Lowell and Fall River, in the State of Massachusetts; Providence, in Rhode Island; and Hudson in New York, are the principle printing establish-

ments in the United States : at all of these places printed goods are produced equal to any in England.

Great Falls is about four miles from Dover, and situated on the same river ; at this place, there are four large elegant Cotton Factories, containing in all about 39,840 spindles, (16,000 of which are mules) and 1132 looms. This is one of the pleasantest and most beautiful manufacturing villages I have ever seen. There are four large Mills, but two of them form one connected building. These are situated in a straight line, at the distance of about one hundred yards from each other ; the canal which supplies them with water runs in front of the Mills, leaving a level space between them about 30 or 40 yards broad ; on each side of this there is a row of young trees planted so as to form a delightful promenade in front of the Mills ; on the opposite side of the canal from the Factories, there is a large open space of ground rising with a gentle acclivity, about 100 yards broad, on the outer verge of which, is the main street of the village : this open ground between the canal and the Main Street, is entirely appropriated as a common, and may be used by the inhabitants as a play ground, bleaching green, or for pasture. Along the outside of the Main Street are the boarding or dwelling-houses for the Mill workers ; these are neat brick buildings, three stories in height, and each building contains four tenements : there are seven of these boarding houses, set at equal distances from each other, which gives to the whole an appearance of neatness and uniformity. The Main Street, the Canal, and the Mills, all running in parallel lines with a large open area between them, have a most

delightful effect upon the mind of a stranger when he first enters the village. The whole plan of the village displays good taste, and its general appearance is delightful and beautiful in the highest degree. A great sum of money has been sunk in this place; and it is said that the proprietors have never realized the interest of the money advanced. Yet judging from the general appearance of the inside of the Factories, I do not see how they cannot be turned to very good account. The goods made are shirtings, sheetings, and printing cloth.

SACO.—The last of the manufacturing villages which we shall notice, though not the least in importance, is that of Saco, in the State of Maine. This village takes its name from the river *Saco*, which runs through it, and is one of the largest rivers in New England: it rises in the White Mountains of New Hampshire, the summits of which are so elevated as to be covered with snow throughout the greater part of the year; and the melting of this snow in summer is a never-failing source of supply to the river, so that in the greatest drought of summer there is water sufficient for driving ten or twelve large Factories. The river is about 160 miles in length; but being much broken by falls, it is not navigable to any considerable extent. There are four principal Falls; first, Great Falls at Hixam, the height of which is about 72 feet; second, Steep Falls at Lymington, about 20 feet; third, Salmon Falls at Holles and Buxton, about 30 feet; and fourth, Saco Falls, about 34 feet: the latter are about four miles from the mouth of the river, which is navigable for vessels of nearly 200 tons, till within one hundred yards of

the Falls. From the mouth of the river a most beautiful beach of smooth level sand stretches along about ten or twelve miles to the Eastward: this is a place of great resort for pleasure parties in the summer season, and it is said this beach is unequalled by any on the whole American coast. It is only about four miles from the village of Saco, and as the population of the place increases, its close vicinity to the sea cannot fail to add to its value and importance.

The river at this place may be about one hundred yards broad, and as it approaches the village, it divides into two branches, and forms three separate Islands, the largest of which is called Factory Island, and contains about thirty acres of ground; on each side of this Island there are large waterfalls of about thirty-four feet; that on the North side is perpendicular, but on the South, the water rolls over several ledges of huge rocks; and in the spring, when the river is swollen by the melting of the snow, as it tumbles over these Falls it presents a scene of the most terrific grandeur. This river, however, is not like the rivers in Britain, which swell with every heavy rain, and again subside as soon as the rain is over. The Saco swells a little in the fall of the year in consequence of the continued rains at that season, but it gradually subsides during the frost in winter; and again, when the snow melts in the spring, it rises, perhaps, two or three feet, and afterwards gradually and slowly subsides during the summer; but a heavy rain continued for a whole day, will scarcely affect the river, unless such days occur frequently during some weeks.

Factory Island belonged to a family of the name of Cutts, some of whose ancestors purchased it from the Indians, who, it is said, resorted to this place in considerable numbers, as well for the purpose of fishing at the Falls, as to obtain a secure retreat from their enemies. In 1825 it was purchased by a Company, principally from Boston, for the purpose of erecting a Cotton Factory. The whole cost to the Company was 110,000 dollars; they, at the same time, bought a considerable part of the privileges on the opposite side of the river for 10,000 dollars. A Mill was erected in 1826, and a canal cut from the head of the Falls to the Mill site. The length of the Mill was 210 feet, the breadth 47, and it was seven stories in height. This was the largest Factory ever attempted in America; it was calculated to operate about 12,000 spindles and 300 looms. In 1829 there were about 500 workers employed about the establishment, the greater part of whom occupied the Company's tenements, which were erected upon the Island. The whole machinery, on which the sum of 200,000 dollars had been expended, was completed in the early part of 1830. This Mill, however, was no sooner completed, than it was burned down to the foundation, and the Company lost all their stock. The wreck of the Mill, with all the other property, was sold at a very low price to another Boston Company, who obtained a charter under the name of the "York Manufacturing Company of Saco." This Company immediately commenced building their first Factory on the foundation of the one which had been burned, the length and breadth of which is the same as the former, but the

height is only four stories and an attic; this Factory was completed in 1833. Afterwards the canal was lengthened so as to convey water to other two Mills, which have since been erected, one of which was completed in 1835, the other in 1837. (*See View of York Factories facing title page.*) These are both 142 feet in length by 42 in breadth within the walls, and four stories in height besides the attics. There are in the three Mills 17,856 throstle spindles, and 568 looms in operation, consuming 39,000 lbs. of cotton, and producing upwards of 105,000 yards of cloth per week. The goods manufactured at these works are Drillings, Jeans, and a variety of striped and coloured goods; the latter are dyed partly in the wool, and partly in the yarn. This method, of dying in the wool, or the cotton, is the simplest and cheapest mode of colouring goods; and I am not aware that it has ever been tried in Great Britain. By mixing together two or three different colours of cotton, they become perfectly incorporated; and this combination of colours produces a shade which no dyer can give to yarn: a variety of superior grounds for striped cloths are obtained in this way, which could not be obtained when the whole has been dyed in the yarn. There are three Companies in this country which make these kinds of goods. They are made by the Hamilton Corporation in Lowell, and by another Company in Philadelphia; but those made by the York Manufacturing Company at Saco, are the best that are made in the United States. The best and finest Jeans manufactured in America are also made at these works: there are likewise two qualities of bed ticking manufactured by this Com-

pany; the first quality is decidedly superior to anything of the kind in the Boston market. Indeed there are no cotton goods manufactured in this country that stand higher in the public markets than those of the York Manufacturing Company. Samuel Batchelder, Esq. is the Company's Agent, under whose able superintendence the whole concern has been got up, and to their first purchase they have since added a great deal of real estate, besides securing the whole water privileges on both sides of the river. Their capital stock is 1,000,000 dollars = £208,333 . 6 . 8 Sterling. They have some very valuable Mill sites, which they are willing to sell to other Companies; and few places in the United States possess equal advantages for manufacturing. Situated at the head of tide water, which flows up to the Falls, cotton may be landed from vessels within one hundred yards of the Mill, and goods immediately shipped in its place, the whole cost of the carriage to and from Boston, being only one dollar per ton;\*

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\* In reference to cost of transportation, a correspondent of the Portland Advertisers has the following calculations:

"The article lately published in your paper respecting manufacturing, induces me to send you some calculations on the subject.

"In yours of the 13th you remark, that the contiguity of Manufacturing Establishments to the sea board, by which the expense of transportation is saved, is an important item in the calculation of profits.

"The full importance of this item of expense is seldom taken into consideration.

"A Cotton Mill of 5,000 spindles will, at a moderate estimate, manufacture one ton of goods per day, such as are usually made in this country, requiring the transportation of 300 tons per annum of cotton to the Mill, and the same amount of goods to market. A

building materials are inexhaustible—vast quantities of bricks are made for exportation, and there are valuable granite quarries, together with abun-

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fair estimate of the cost of land transportation is 7 dollars per ton per 50 miles. Suppose such a Mill to be situated 50 miles from market, or from water communication, there would be 600 tons per year, requiring transportation at an expense of 4,200 dollars.

“ Or suppose the situation to be such as to require a transportation of 50 miles by rail-road or canal, the expense cannot be estimated at less than 3 dollars per ton, amounting to 1800, and this is the cost of the transportation of the cotton and goods only, without taking into view any other materials, such as oil, iron, flour, starch, and various other articles necessary in the business.

“ The cost of transportation from Boston to such Mills as are situated on or near the tide waters in the State of Maine, is one dollar per ton, and if you allow something more for insurance, as much may fairly be deducted for saving in the transportation of other materials, and for bringing the cotton or part of it directly from Mobile, Charleston, &c., without the expense of transhipment at Boston.

“ The annual cost of transportation, therefore, for such a Mill situated on the tide waters in this State, would be 600 dollars, making a difference against a Mill, requiring 50 miles transportation by canal or rail-road, of 1,200 dollars per annum, or compared with one requiring 50 miles land transportation of 3,600 dollars. This sum, it must be recollect, is a permanent annual expenditure, and is therefore equivalent to a capital of which this would be the interest, which, in one of the cases above-mentioned, would be 20,000 dollars, and in the other 60,000. The result would therefore be, that it would be better to pay 60,000 dollars for the water power and Mill site for such a Factory at some of the Falls in this State in the tide water, rather than to establish the business 50 miles in the interior, if the Mill site could be had for nothing. And that it would be good economy to pay 20,000 dollars more for such a Mill site here, than the cost of one similar in all other respects, which should require 50 miles of rail-road or canal transportation.”

dance of lumber, all of which offer a rare combination of facilities for building extensive works. The Eastern Mail Stage passes daily over the Island, and the Eastern Railway is intended to pass through the village, which will greatly facilitate the intercourse between this and Boston: the distance being 100 miles, it is expected the rail-road cars will travel that length in five hours; so that leaving this place early in the morning, a person may go to Boston and do business for four or five hours, and return again in the evening.

The population of Saco is upwards of 4000 souls, and Biddeford, on the opposite side of the river, contains above 3000. There are in the village six places of public worship, four Free Schools, besides a number of private ones, and an Academy, where the various branches of useful education are taught: also, a Circulating Library, Public Reading-room, three large Hotels, and two Banks; and there are two Newspapers published weekly. The place is still increasing in wealth and extent, as every new Factory that is started adds about 500 to the population.

## MISCELLANIES.

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### DYNAMOMETER.

A MACHINE has been used at Lowell, called a Dynamometer, for the purpose of ascertaining the power required to move any of the different machines used in Cotton Factories, but having never seen it, I cannot give any description either of its construction, or of the mode of applying it. It is said, however, to be rather complex, and that the results given by it cannot be entirely relied on. My design at present is merely to describe a very simple one lately constructed by Samuel Batchelder, Esq., Agent of the York Manufacturing Co. Saco.

Plate VIII. *figures 1st and 2d.* gives two views of this machine, which is constructed on the principle of what is called the “differential box,” and consists of the two pairs of belt pulleys A A, B B, mounted on the shaft C C: one of these pulleys on each side is loose, while the other is fast. The fast pulley on the side A A, and the bevel wheel D, are both fastened to the shaft C C. The bevel wheel F is fastened on a small tube connected with the pulley B. The wheels E E, are connected by G, which is constructed so as to revolve round the shaft C C. To apply this simple machine, a belt from a drum on the main driving shaft is brought to the pulleys A A, whilst another belt is carried from the

pulleys B B, to the machine or machinery, the weight of which is to be ascertained. And it is plain, that if the pulleys A A, and the wheel D, are once put in motion, the wheels E E will also revolve on their axis, and at the same time the connection shaft G will revolve round the shaft C C, thus leaving the wheel F and the pulleys B B, standing still ; but, if the wheels E E are kept in their present horizontal position, and prevented from revolving round the shaft C C, it is equally obvious, that the wheel F and the pulleys B B will then be moved at the same speed as the wheel D and the pulleys A A; hence the weight required to keep the wheels E E in their present position, is equal to the weight required to move the pulleys B B. The weight thus required, is found by means of the lever H J. The arm H is attached to the centre of the wheels E E, by the straps *a a*, *fig. 1st*. The arm J is divided upon the principle of the Roman steel yard. The weight M is merely intended to balance the arm J, and being fastened with a set screw, can easily be shifted on the arm H, as may be found requisite. Therefore, when the wheels E E are kept in their present position by means of the lever J H, it is evident that a weight of 20 lbs. acting upon the pulleys A A at P, will balance another of the same weight at N, of the pulleys B B. Now the distance from the centre of the shaft C C to the division on the lever J marked 1, is equal to the radius of the belt pulleys ; hence a weight of 20 lbs. at 1 will counterbalance the same weight at P, that is making no allowance for friction, the amount of which is ascertained by the additional weight required to balance

the given weight at P; and having once ascertained the proper allowance for friction, the machine is put in motion by shifting both belts on to the fast pulleys, and moving the balance weight along the lever J from 1 to 4, 8, 12, or to whatever number will balance the wheels E E, and the weight thus indicated on J, is the weight required to move the machine or machines, from which deduct the allowance for friction. A worm at y on the end of the shaft C C, works into a wheel with an index and pointer, in order to show the speed at which the machine is driven, and also to determine the difference of the weight of any machine at different speeds. From the above description it is presumed that the principle upon which this dynamometer is constructed, as well as the mode of applying it, will be easily understood.

**PRICES OF MACHINERY AND VARIOUS OTHER ARTICLES USED IN COTTON FACTORIES, BOTH IN GREAT BRITAIN AND AMERICA.**

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*Prices of Machinery, &c. at Lowell, Massachusetts.*

	Dols.	Cts.	£	s.	d.
Conical Willow, . . . . .	110	0	=	22	18 4
Whipper used, instead of a Willow, for beating Cotton, . . . . .	95	0	=	19	15 10
Picker or Spreading Machine (two beaters)	550	0	=	114	11 8
Carding Engine, 37 inches broad, and 36 inches diameter, clothed, . . . . .	260	0	=	54	3 4
Lap Winder or Lapping Machine, . . .	240	0	=	50	0 0
Drawing Frame of three heads, . . . .	165	0	=	34	7 6
Speeder containing 24 spindles, . . . .	850	0	=	177	1 8
Stretcher or Extenser, 36 do. . . . .	1,000	0	=	208	6 8
Spinning Frame, 128 do. (dead spindle)	575	0	=	119	15 10
Warping Machine, complete, . . . . .	135	0	=	28	2 6
Dressing Machine, do. . . . .	500	0	=	104	3 4
Loom, do. . . . .	75	0	=	15	12 6
Belt Leather, $\frac{3}{4}$ pound, . . . . .	0	26	=	0	1 1
Lacing or thong Leather for sewing belts, $\frac{3}{4}$ side, about . . . . .	1	0	=	0	4 2
Sheep skins for covering rollers, cut into strips to suit the rollers, $\frac{3}{4}$ dozen, . .	8	0	=	1	13 4
Calf skins for covering rollers, $\frac{3}{4}$ dozen,	22	0	=	4	11 8
Picker Leather, cut into strips for shuttle cords, $\frac{3}{4}$ side, . . . . .	6	0	=	1	5 0
Shuttle Drivers, made of Buffalo hide, $\frac{3}{4}$ doz.	0	67	=	0	2 9 $\frac{1}{2}$
Sperm Oil, $\frac{3}{4}$ gallon, . . . . .	0	90	=	0	3 9
Tallow, $\frac{3}{4}$ lb. . . . .	0	7	=	0	0 3 $\frac{1}{2}$
Dust or hand Brushes, $\frac{3}{4}$ dozen, . . . .	4	0	=	0	16 8
Floor Brushes, $\frac{3}{4}$ dozen, . . . . .	10	0	=	2	1 8
Reeds, (Steel) $\frac{3}{4}$ beer, or 20 dents,	0	4	=	0	0 2
Do. (Brass) do. do. . . . .	0	5	=	0	0 2 $\frac{1}{2}$

	Dols.	Cts.	£	s.	d.
Reeds, (Cane) $\frac{V}{W}$ beer, or 20 dents, . . . 0 3½ = 0 0 1½					
Card Sheets and Fillets, $\frac{V}{W}$ square foot, . 1 12½ = 0 4 8½					
Shuttles, (Apple tree) $\frac{V}{W}$ dozen, . . . 5 0 = 1 0 10					
Bobbins for Speeder, 6 inches by 4, each . . . 0 6 = 0 0 3					
Do. for Spinning Frame, (Birch) do. . . . . 0 1 = 0 0 0½					
Do. for do. (Apple tree) $\frac{V}{W}$ 1,000, . . . . . 12 50 = 2 12 1					
Potato Starch for dressing, $\frac{V}{W}$ lb. . . . . 0 5 = 0 0 2½					
Brass Castings, $\frac{V}{W}$ lb. . . . . 0 30 = 0 1 3					
Iron do. do. 5 cents to . . . 0 6 = 0 0 3					

*At Pawtucket, Rhode Island.*

	Dols.	Cts.	£	s.	d.
Looms, . . . . . each, 75 0 = 15 12 6					
Dressing Machines, . . . . . do. 425 0 = 88 10 10					

*The Providence Machine Company*

Make very superior Mules for  $\frac{V}{W}$  spindle, 2 75 = 0 11 5½

*At Andover, in Massachusetts.*

	Dols.	Cts.	£	s.	d.
Speeders containing 18 spindles, . . . . . 666 0 = 138 15 0					
Stretchers or Extenders, containing 36 spindles, . . . . . 1,080 0 = 225 0 0					
Spinning Frames, $\frac{V}{W}$ spindle, . . . . . 4 0 = 0 16 8					

According to the statements of some experienced machine makers, a Mill containing 4,000 spindles, with all the necessary machinery for weaving, &c. might be filled with machinery ready for operation, for about 55,000 dollars, equal to 13 dollars 75 cents, or £2 . 17 . 3½ per spindle; and including buildings, gearing, &c. for 20 dollars, or £4 . 3 . 4 per spindle.

*Prices of Machinery, &c. in Glasgow, Scotland.*

	£	s.	d.	Dols.	Cts.
Cylindrical Willow, . . . .	20	0	0	= 96	0
Scutching Machine, with two beaters,	58	0	0	= 278	40
Spreading Machine for 24 inch cards,	52	0	0	= 249	60
Do. do. 36 do.	58	0	0	= 278	40
Carding Engine, 24 inches broad, and 36 in diameter, clothed and ready for operation, . . . .	£28 to £30	0	0	= 144	0
Carding Engine, 36 inches broad, and 36 in diameter, clothed, &c.	44	0	0	= 211	20
Lapping Machine or Lap Winder, 24 inches, with 4 calender rollers, . . .	25	0	0	= 120	0
Fly Frames, per spindle, . . . .	1	18	0	= 9	12
Drawing Frames, per head, . . . .	9	0	0	= 43	20
Mules, per spindle, . . . .	0	6	0	= 1	44
Spinning Frames, (live spindle) per spindle, 0 10 6 =	2	52			
Looms, . . . .	9	0	0	= 43	20
Dressing Machine, . . . .	40	0	0	= 192	0
Warping Machine, . . . .	17	0	0	= 81	60
Winding Machine, . . . .	10	0	0	= 48	0
Belt Leather, per lb. . . . .	0	1	6	= 0	36
Lacing or Thong Leather, per skin, . .	0	1	6	= 0	36
Sheep Skins for covering rollers, per dozen,* 1 2 0 =	5	28			
Shuttles, (Boxwood) with wheels, per doz. 1 14 0 =	8	16			
Do. do. with iron slides do. 1 10 0 =	7	20			
Shuttle Drivers, (Birch) do. 0 0 7 =	0	14			
Reeds, (Brass) per hundred splits, . .	0	0	3½	= 0	7
Do. (Steel) do. 0 0 3 =	0	6			
Dust brushes, per dozen, . . . .	0	11	0	= 2	64
Floor do. do. . . .	1	10	0	= 7	20

\* The Sheep Skins used in Great Britain are equal in quality to the Calf Skins used in America, and are fully double the size.

	£	s.	d.	Dols.	Cts.
Sperm Oil, per gallon, . . . . .	0	7	0	=	1 68
Tallow, per lb. . . . .	0	0	5½	=	0 11
Bobbins for Fly Frames, 6 inches by 3, per dozen, . . . . .	0	1	9½	=	0 43
Bobbins for Spinning Frames, per dozen, . . . . .	0	0	8	=	0 16
Flour for Dressing, per barrel, (1839) . . . . .	1	17	0	=	8 88
Brass Castings, per lb. . . . .	0	1	2	=	0 28
Iron do. do. . . . .	0	0	1½	=	0 3
Card Sheets, (Breakers) 24 inches by 3½ per sheet, . . . . .	0	3	3	=	0 78
Card Sheets, (Finishers) 24 inches by 3½, per sheet, . . . . .	0	3	5½	=	0 83
Filletting, (Breaker) 1½ inches broad, per foot, . . . . .	0	0	10	=	0 20
Filletting, (Finisher) 1½ inches broad, per foot, . . . . .	0	0	10½	=	0 21

*Prices of various Machines in Manchester, England, from Dr. Ure's Work on the Cotton Manufacture of Great Britain.*

	£	s.	d.	Dols.	Cts.
Conical Willow, . . . . .	70	0	0	=	336 0
Scutching Machine, (two beaters) . . . . .	70	0	0	=	336 0
Spreading Machine, do. . . . .	70	0	0	=	336 0
Carding Engine, 37 inches broad, and 42 inches diameter, unclothed, . . . . .	42	0	0	=	201 60
Clothing Furniture of do. . . . .	24	0	0	=	115 20
Drawing Frame of six heads, . . . . .	37	10	0	=	180 0
Fly Frame, (coarse) per spindle, . . . . .	2	6	0	=	11 4
Do. (fine) do. . . . .	1	11	10	=	7 64
Mules, per spindle, . . . . .	0	4	9	=	1 14
Self-acting Mule, per spindle, . . . . .	0	8	0	=	1 92
Spinning Frame, (live spindle) per spindle, 0 10 6 =	0	10	6	=	2 52

From the preceding statements it will be seen, that the prices of machines used in the cotton manufacture, are much higher in this country than in Great Britain: besides, the British machinery generally contains a greater number of improvements, or those little contrivances by which they can be more easily adjusted, and operated to the best advantage.

Mr White, in his Memoir of Slater, gives the following Extract from Baine's History of the Cotton Manufacture in England.

	<i>Prices of machinery in England, 1834.</i>		<i>Prices of machinery in the United States, 1834.</i>		<i>Actual prices sold in U. S.</i>	
	D. C.	D. C.	D. C.	D. C.	D. C.	D. C.
Carding Engines,	£30 to £40	144 to 192	£40 to £50	192 to 240	100 to 250	
Throstles, $\frac{3}{4}$ spindle,	8s. to 9s.	1. 92 to 2. 16	24s. to 26s.	5. 76 to 6. 24	4.25 to 6	
Mules, $\frac{3}{4}$ do.	4s. 6d. to 5s.	1. 8 to 1. 20	13s. to 14s.	3. 12 to 3. 36	2.12 to 2.25	
Dressing Machines,	£30 to £35	144 to 168	£80 to £90	384 to 432	400	
Power Looms, .	£7½ to £8½	36 to 40.80	£12 to £16	57.60 to 76.80	50 to 75	

On the above Extract Mr White has the following note :—

“ The fact respecting the higher prices of American machinery, arises from their ornamental work, which the English think unnecessary; as they regard only the utility and durability of the machine. This circumstance may be worthy the attention of our machinists; whether it is best to spend so much for polishing the appearance of the works.”

In the preceding statement Mr White is greatly mistaken, as the English machinery in general, is more highly polished than any that I have yet seen in America. A great part of the framing of machinery in this country is made of wood, painted green, which is the prevailing colour for the wooden

part of all the machinery here ; but this can never have so good an appearance as bright polished iron, with which all the machinery made in Glasgow and Manchester is mounted. Let any one who supposes that the British do not expend labour and expense in polishing or ornamenting their machinery, only visit Mr Orrell's Mill at Stockport, England, and he will find there a Factory fitted up like a palace. Indeed, all the Factories lately built in England and Scotland have a splendid and elegant appearance, at least much more so than those of this country.

### COST OF STEAM POWER IN THE UNITED STATES.

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The following estimate of the cost of steam power is taken from a Mill in Massachusetts containing

One Willow and Spreading Machine, with three beaters.

26 Carding Engines, 18 inches broad, and 36 inches diameter.

One Drawing Frame of three double heads.

Six Mules containing 264 spindles each = 1,584 spindles.

Spinning Frames, (dead spindle) . . = 2,116 do.

3,700 spindles.

Three Warping Machines.

Three Dressing Machines dressing 35 pieces of 30 yards,  
= 1050 yards each, or 3,150 yards in all, per day.

100 Looms, making 112 picks per minute, yarn No. 30, for  
printing Cloth.

The Mill is driven by two large belts, from a high pressure steam engine of 40 horses' power—length of stroke, 4 feet—diameter of cylinder, 1 foot—makes 20 double, or 40 single strokes per minute. There are four round boilers, each 15 feet long by  $2\frac{1}{2}$  in diameter—requiring 300 gallons of water, and consuming  $1\frac{1}{2}$  chaldrons of bituminous coal per day—pressure of steam, 68 lbs. to the square inch.

	Dols. Cts.
1 $\frac{1}{2}$ chaldrons of bituminous coal @ 8 dol. $\frac{3}{4}$ chald.	10 0 $\frac{3}{4}$ day.
Wages of Engineer, . . . . .	1 33 do.
Do. Fireman, . . . . .	0 87 do.
	<u>12 20</u>

Thus, the daily cost of the above engine is 12 dollars 20 cents, = £2 . 10 . 10 Sterling, besides oil, tallow, stuffing, &c. This is about double the cost of the same power in Glasgow.

CALCULATIONS OF THE COST OF WATER POWER  
AT LOWELL, MASSACHUSETTS; AND MANAYUNK,  
PHILADELPHIA.

*These calculations are entirely for breast wheels, all those at Lowell being of that description.*

At Lowell 3,584 throstle spindles, with all the necessary machinery for preparing the cotton, and manufacturing the cloth, are considered a Mill power, and sold at 4 dollars per spindle, or 14,336 dollars in all, with about four acres of land. In conveying the Property, the Company give a right on the fall of 13 feet, to draw 60 cubic feet of water per second for 24 hours; and 24 cubic feet on the fall of 30 feet. On the fall of 13 feet, one foot is deducted, leaving 12 feet for effective fall.

Cubic feet.   Feet.   lbs.

$$60 \times 12 \times 62\frac{1}{2} \text{ (weight of one cubic foot)} = 45,000 \text{ lbs.}$$

per second.

45,000 lbs.  $\times$  60" = 2,700,000 lbs. of power expended per minute; from which deduct  $\frac{1}{3}$  for the difference between the power expended and the effect produced; 2,700,000 lbs. —  $\frac{1}{3}$  = 1,800,000 lbs. being the effective force of 60 cubic feet per second, on a fall of 13 feet; which, if divided by 33,000 lbs. (Watt's estimate of one horse power,) will give the number of horses' power on the above fall.

$$1,800,000 \div 33,000 = 54.54 \text{ horses' power.}$$

Therefore  $54\frac{1}{2}$  horses' power, (together with four acres of land,) are sold for 14,336 dollars, and are estimated as sufficient to propel 3,584 spindles, with all the other machinery connected.

The whole cost divided by the number of horses' power gives the cost of each.

Dols. Horses' power. Dols.

$14,336 \div 54.54 = 262.85$ . The interest on this at 6 per cent., 15 dollars 77 cents  $= £3.5.8\frac{1}{2}$  Sterling, being the annual cost of each horse power.

If we suppose the land worth 857 dollars per acre, being a little over 17 cents to the square yard, (and it is known that much of the Company's ground brings as much for the square foot,) then four acres will cost 3,428 dollars, leaving 10,908 dollars for the water power, *i. e.* 200 dollars for each horse power; the interest of which is 12 dollars, the annual cost of each horse power to the different manufacturing corporations.

At Manayunk, near Philadelphia, the water is leased or sold by the square inch of the gates, under a head of 3 feet. The whole fall is 23 feet, from which 3 feet is deducted; leaving 20 feet for effective fall.

"The square root of the head or depth of water multiplied by 5.4, gives the velocity of feet per second: this multiplied by the area of the orifice in feet, gives the number of cubic feet which flows out in one second." See *Brunton's Compendium of Mechanics, seventh edition, page 147.*

$\checkmark 3 = 1.732 \times 5.4 = 9.3528$ , velocity per second, or the number of cubic feet per second, running through an orifice of one square foot.

$9.3528 \times 20$  feet, height of effective fall  $= 187.056$  feet  $\times 62\frac{1}{2}$  feet, weight of cubic foot  $= 11,691$  lbs. per second  $\times 60$  seconds  $= 701,460$  lbs. power expended per minute, from which

deduct  $\frac{1}{3}$  for the difference between the power expended and the effect produced.

701,460 lbs. —  $\frac{1}{3}$  = 467,640 lbs. effect produced  $\div$  33,000 lbs.  
 $= 14.17$  horses' power for each square foot of the gates on the above fall of 23 feet, and under a head of 3 feet.

The above water power is sold at 100 dollars per square inch of gate.

Square inch.	Inches in a foot.	Dollars.	Dollars.
1	: 144	:	100 : 14,400 cost of square foot.
14,400 dollars $\div$ 14.17 horses' power	= 1,016 dollars for each horse power.		The interest of which at 6 per cent. is 60 dollars 96 cents = £12 . 14s. Sterling, the annual cost of each horse power; being about equal to 6 dollars for each square inch of gates on the above fall and head of water.

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**RESULT OF AN EXPERIMENT TO ASCERTAIN THE WEIGHT OF ANTHRACITE COALS CONSUMED IN HEATING A COTTON FACTORY FOR ONE WEEK, IN WINTER, BY JOHN M. BATCHELDER, SACO.**

The Mill in which the following experiment was made, consists of four stories, with an attic, and is 42 feet in width by 142 in length; the average height of each story about 10 feet. The attic is about 29 feet in width, and between 8 and 9 in height.

The basement story contains the water wheels; second, the carding; third, the spinning; fourth and attic, the weaving and dressing. The Mill is warmed by means of two upright steam boilers, one at each end of the Factory. One of these boilers is 6 feet in height, by 3 feet in diameter; the other is of the

same height, and  $2\frac{1}{2}$  feet in diameter. The temperature of each room, as well as of the external air, was observed each hour of the 24 on the first day; during the remainder of the week it was observed four times each day, at such times as would give a correct average.

The water supplied to the boilers was of the temperature of  $32^{\circ}$ .

#### The average temperature of

The wheel room or basement story, was	.	$44.24^{\circ}$
— external air,	.	$14.05$

Temperature of wheel room was raised	.	$30.19^{\circ}$
--------------------------------------	---	-----------------

Average temperature of carding room, was	$64.72^{\circ}$
--	-----------------

Do. do. spinning room,	65.94
------------------------	-------

Do. do. weaving room,	66.57
-----------------------	-------

Do. do. attic,	$71.04$
----------------	---------

Average temperature of the four rooms,	$268.27^{\circ} \div 4 = 67.07^{\circ}$
--	---

Average temperature in the Mill,	.	$67.07$
----------------------------------	---	---------

Do. do. of external air,	.	$14.05$
--------------------------	---	---------

Temperature of the four rooms was raised,	.	$53.02^{\circ}$
---	---	-----------------

The temperature was taken night and day, therefore the above was the average of the whole 24 hours of each day during the week.

The lowest temperature of the external air observed during the week, was 8 degrees below, and the highest range 38 degrees above zero; yet the temperature of the several rooms was quite uniform, not varying at any time above four degrees from the average given.

The quantity of fuel consumed in the six days, was 7,484 lbs. of anthracite coal.

$$7,484 \div 6 = 1,247 \text{ lbs. of coal per day.}$$

Cost of 7,484 lbs. anthracite coals at 7 dollars per ton.

Lbs.	Dols.	Lbs.	Dols.	Cts.
2,240	: 7	: 7,484	: 23	. 39

Thus, the cost of coals to heat a Mill of the above extent for one week or six days, during the coldest month in winter, was 23 dollars 39 cents = £ 4 . 17 . 5½, Sterling.

In order to ascertain the annual cost, we may fairly estimate ten weeks in the coldest part of winter equal to the above, and twenty weeks in spring and autumn at one half the above cost. The annual cost would therefore stand as follows :—

Weeks. Dols. Cts.	Dols. Cts.
10 × 23 . 39 = 233 . 90	+ 20 × 11 . 69½ = 467 . 80
$= \text{£} 97 . 9 . 2.$	

The above may be regarded as the fair average annual cost of heating a large Factory in this country by steam. I have not had an opportunity of ascertaining the cost of heating by hot air, as those that heat by the latter use a considerable quantity of wood for fuel.



PLATE 1.

Fig 1<sup>st</sup>

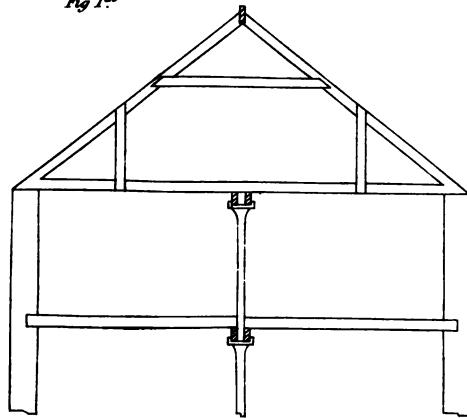
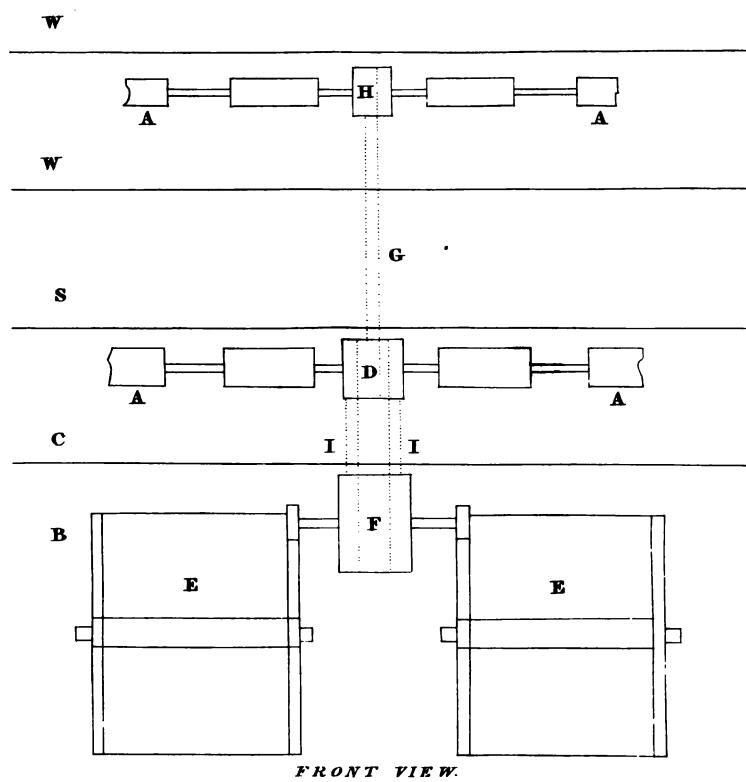
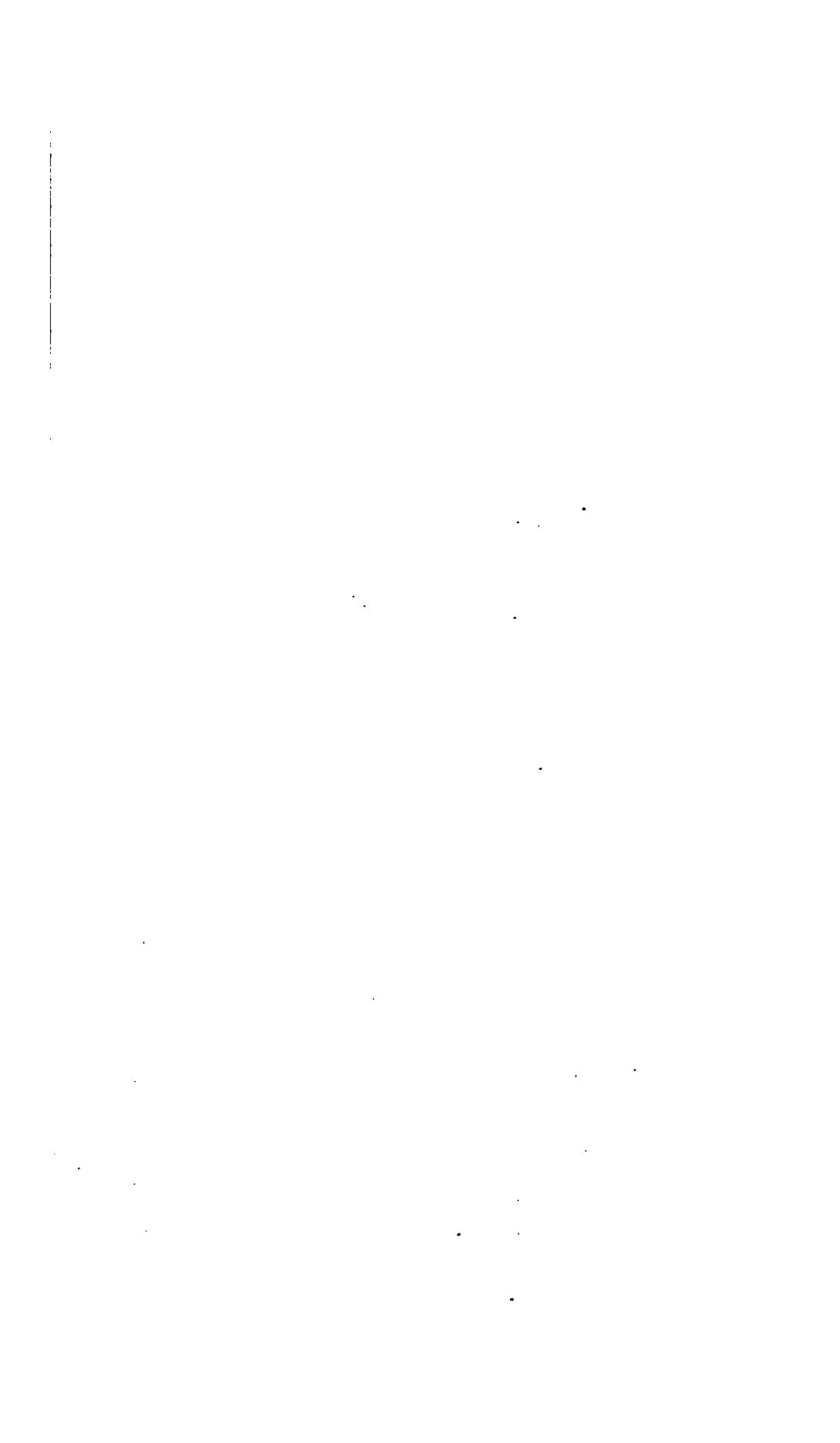


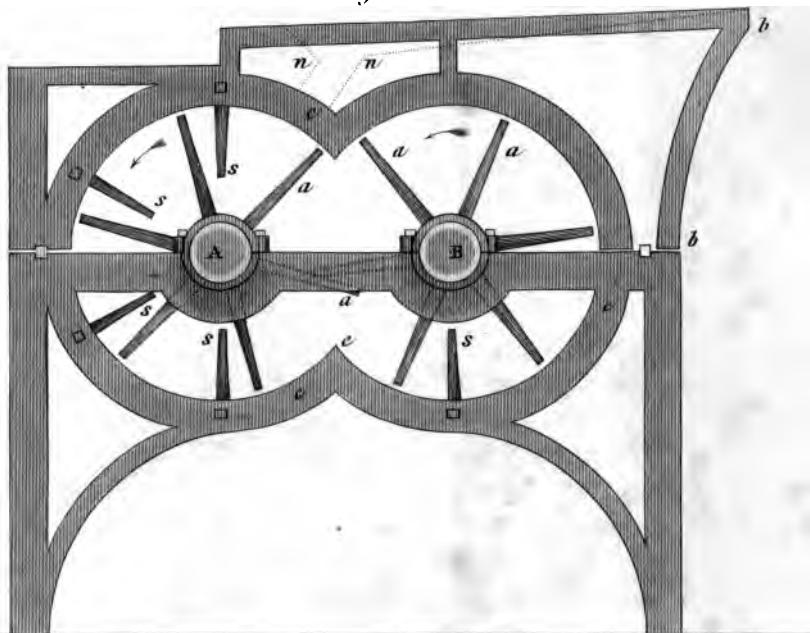
Fig 3<sup>rd</sup>



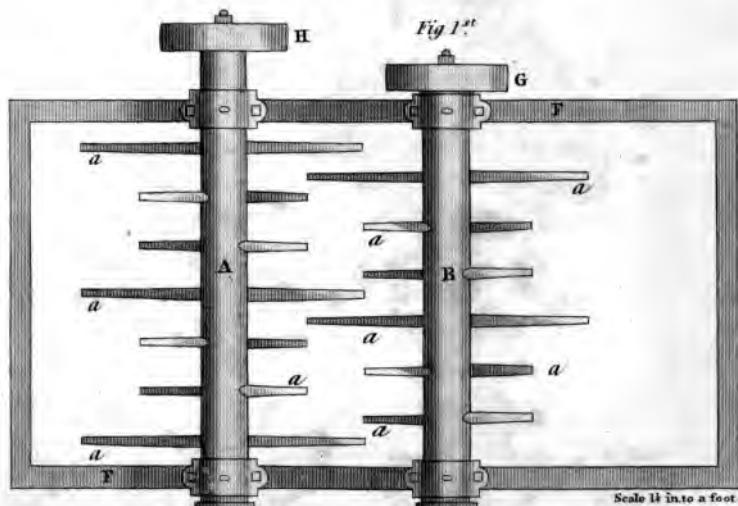


MASON'S WHIPPER.

*Fig 2<sup>d</sup>*



*Fig 1<sup>st</sup>*



Scale 1*in.* to a foot.

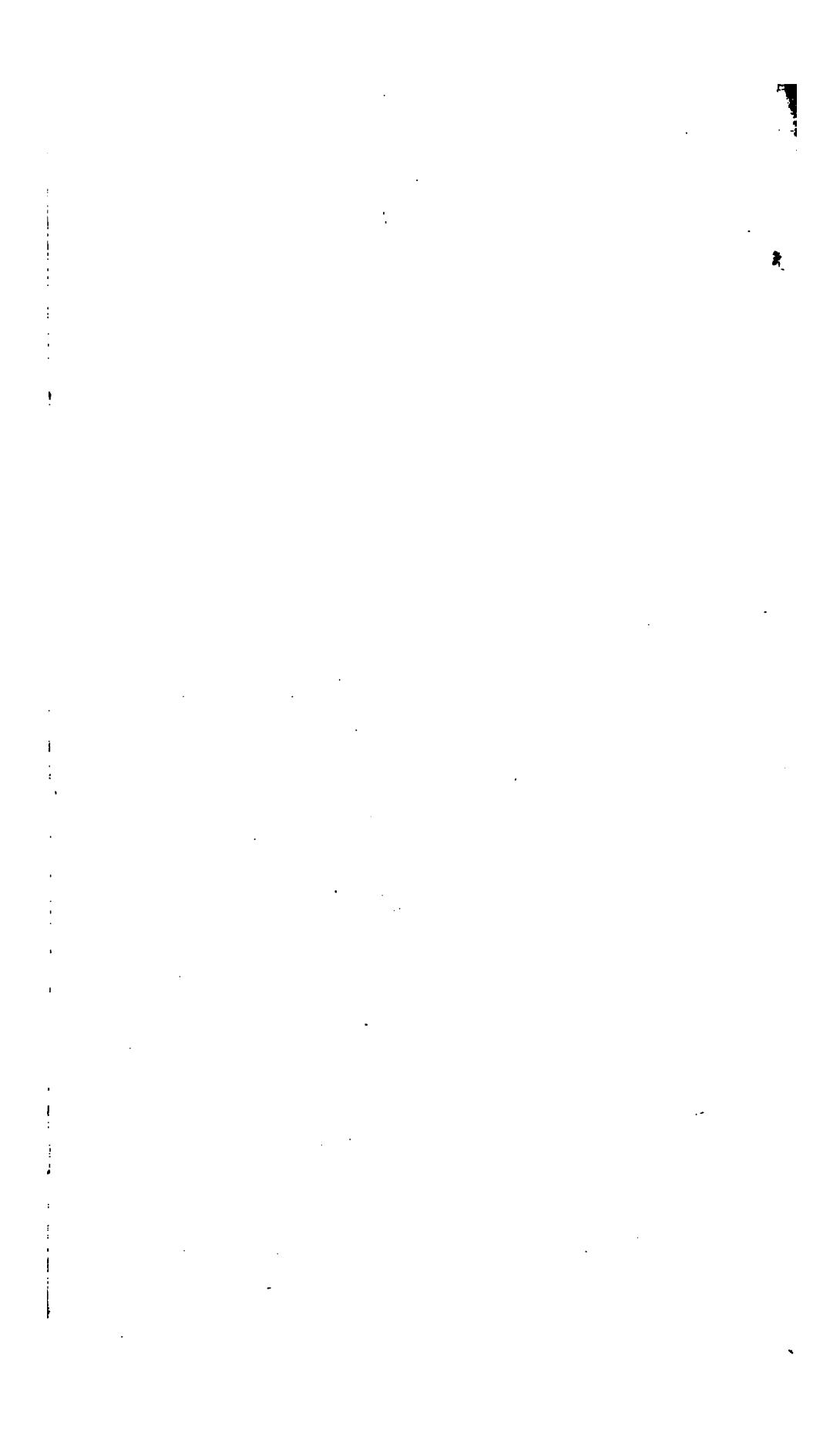
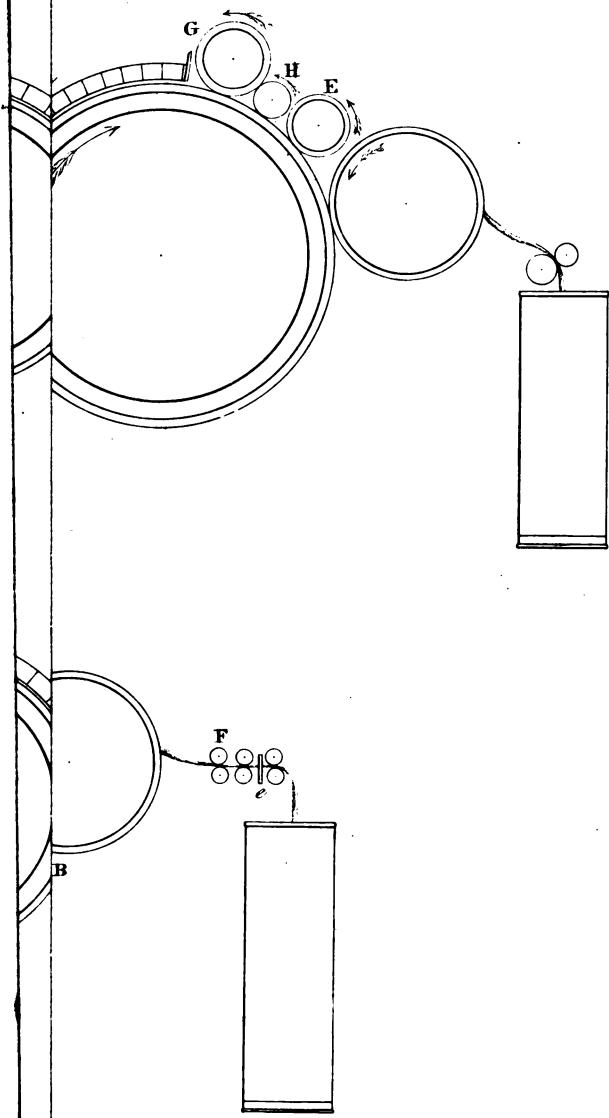


PLATE III.



Scale of one half inch to the foot.

*Swan Sci.*

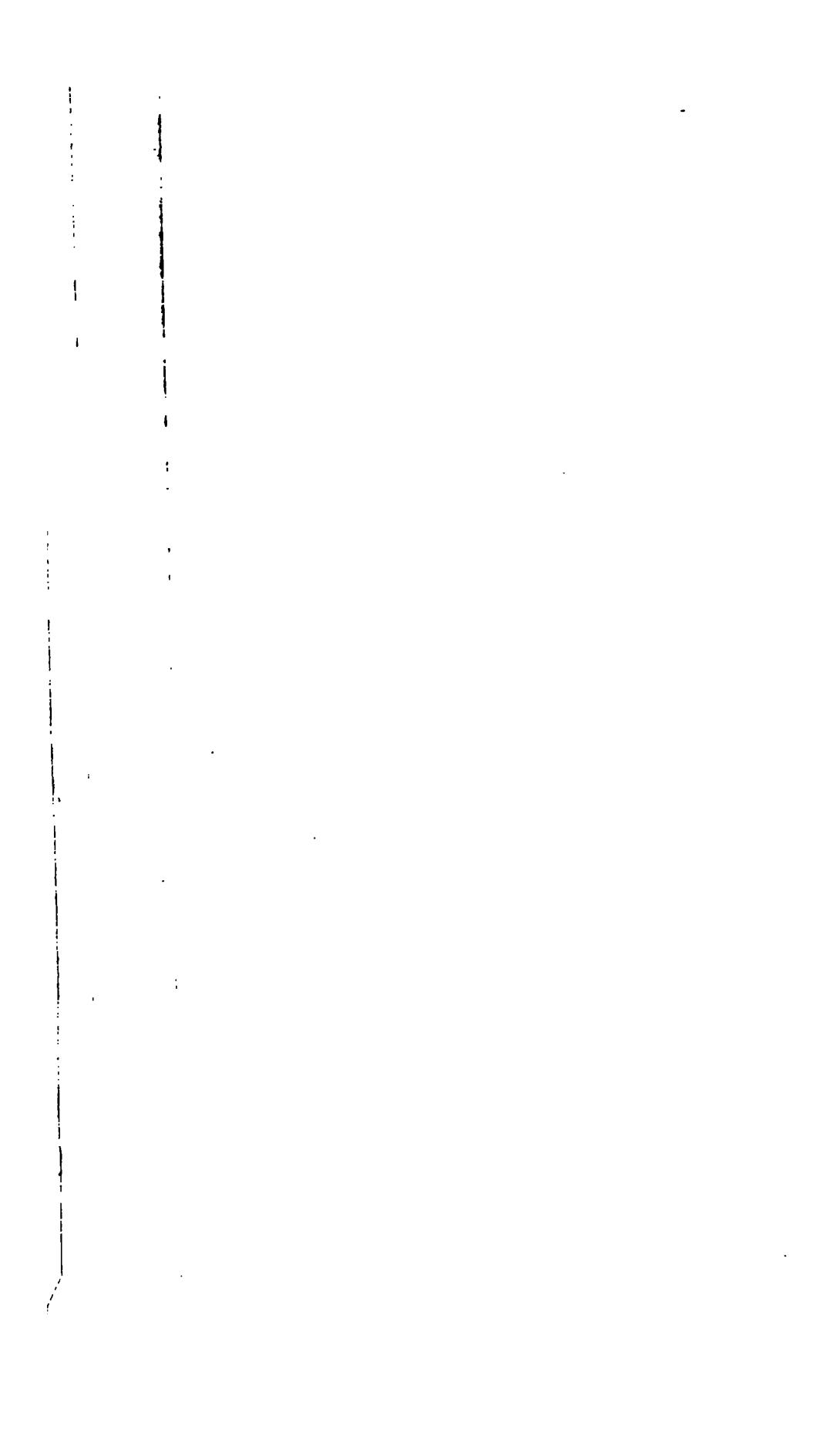
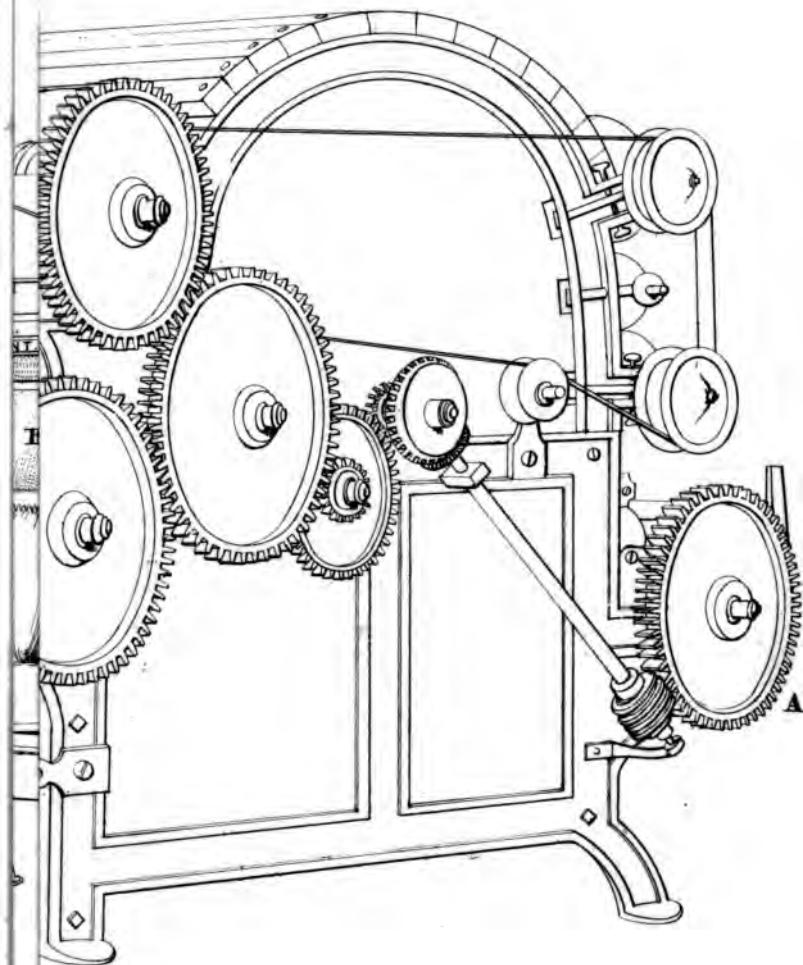


PLATE IV.



Mackay & Macdonald Lith<sup>g</sup> Glasgow.

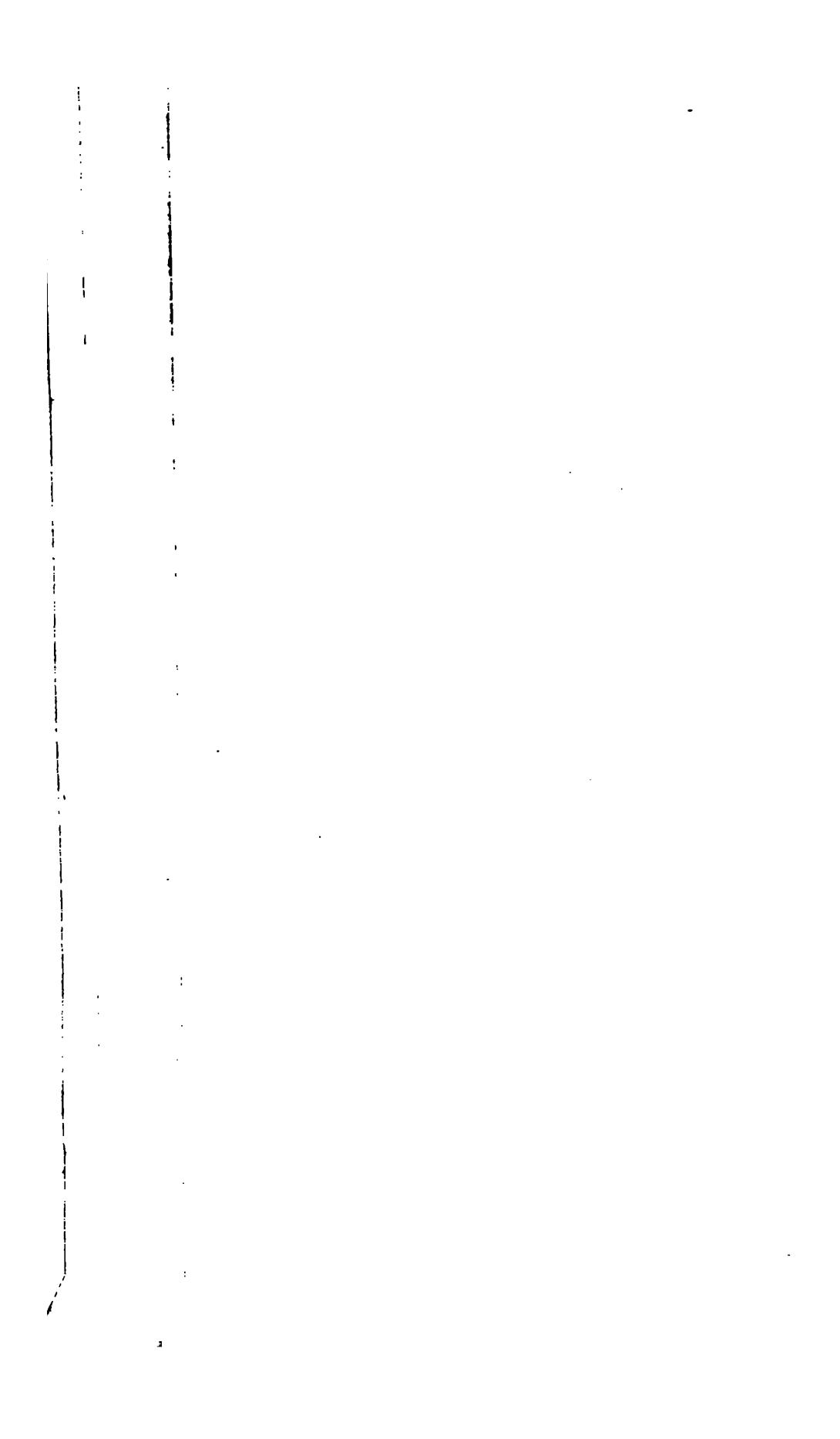
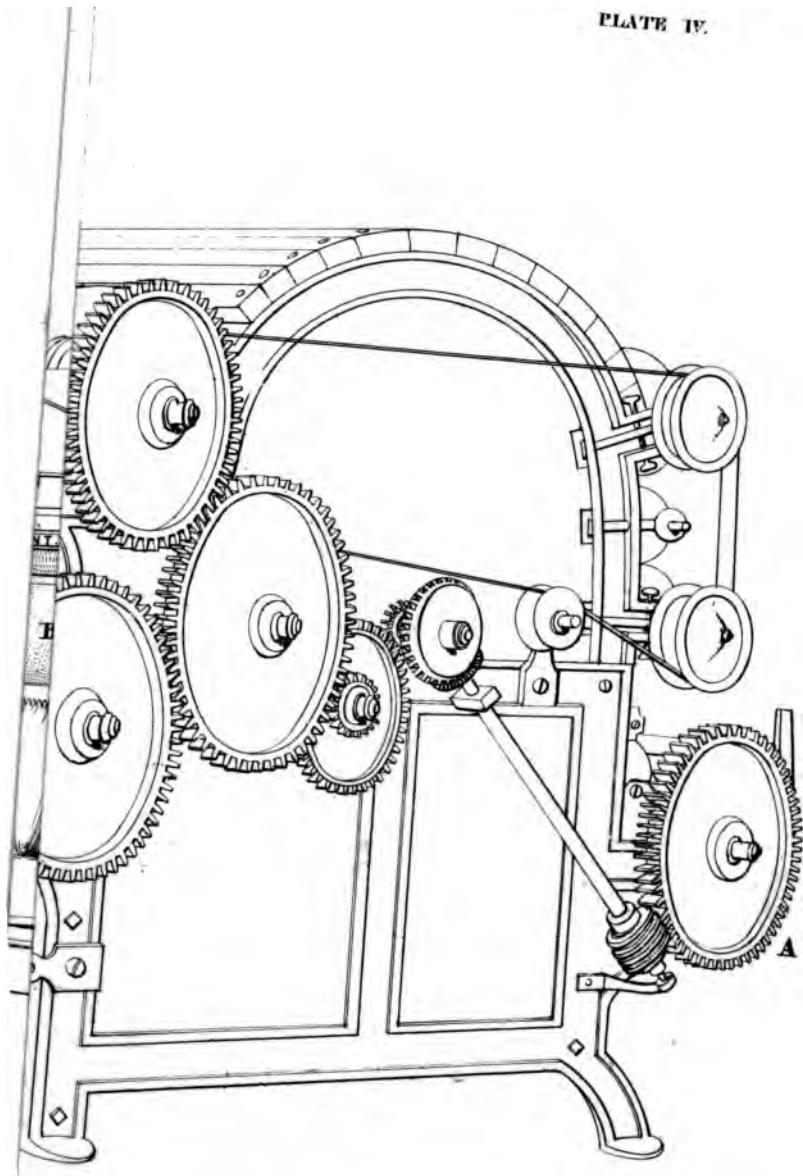
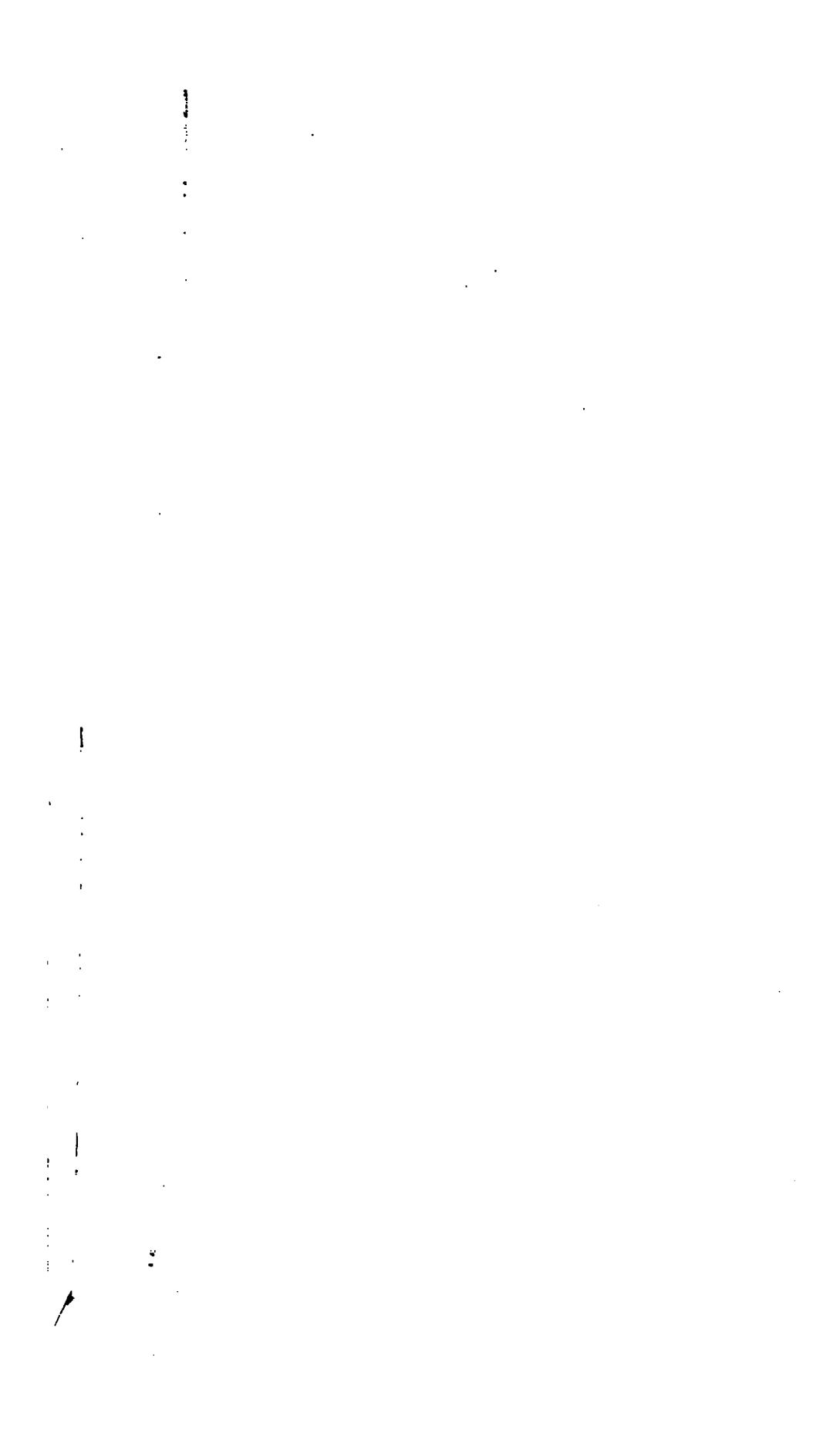


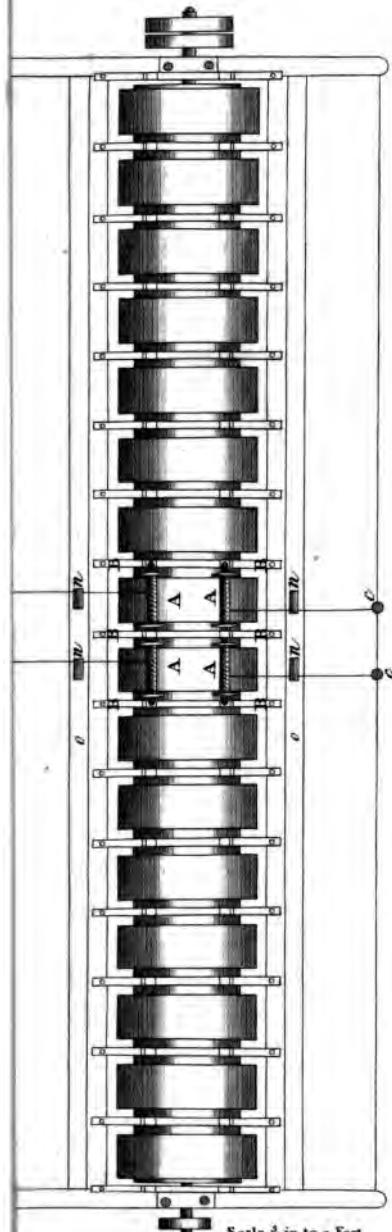
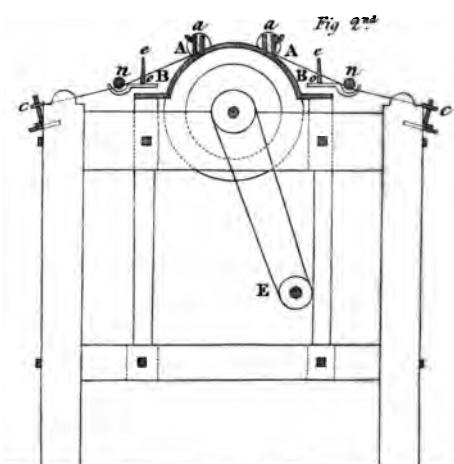
PLATE IV.



MacLure & Macdonald lith<sup>g</sup> Glasgow.



## SPOOLING OR WINDING MACHINE.

Fig 1<sup>st</sup>Fig 2<sup>nd</sup>

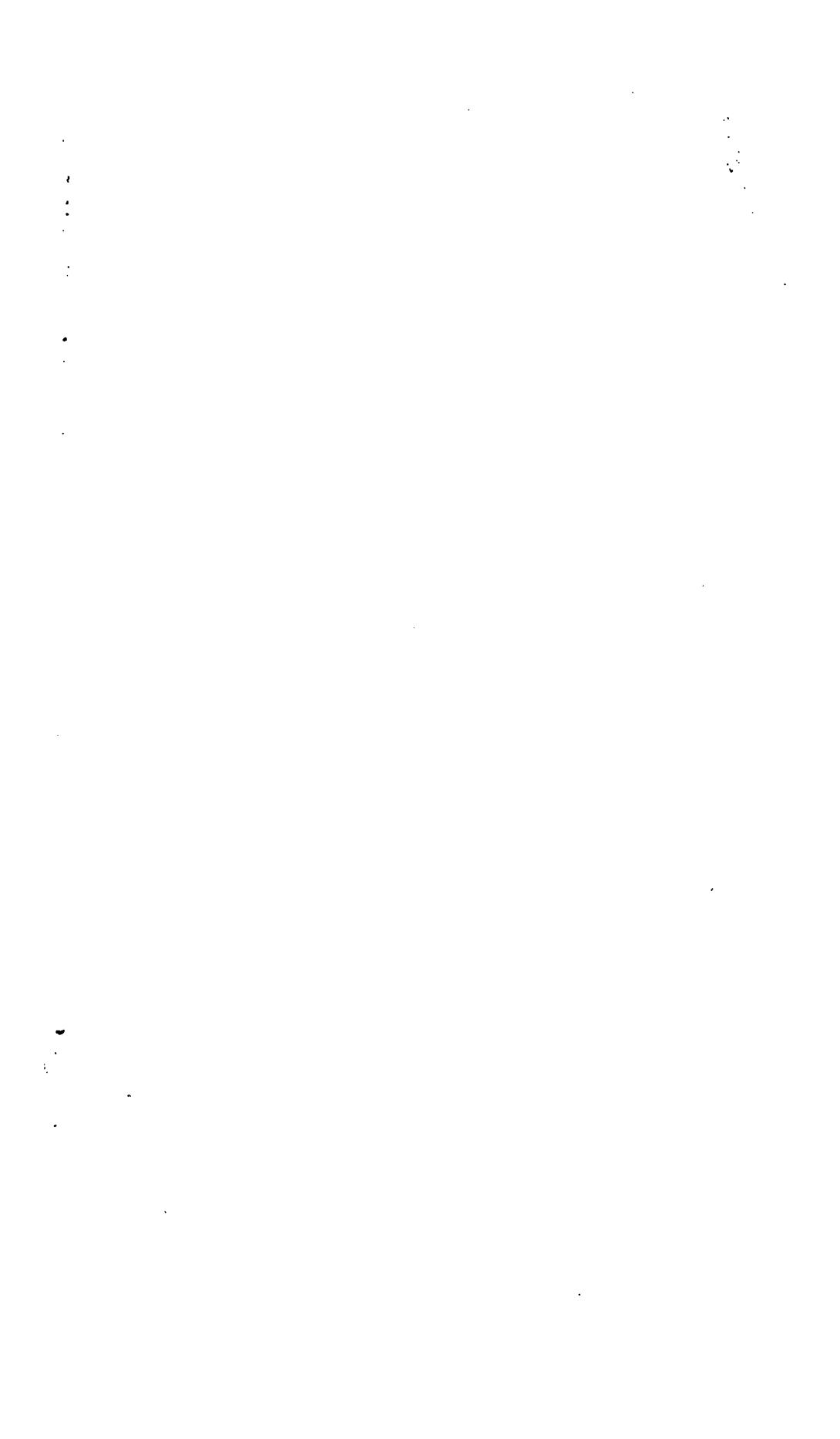
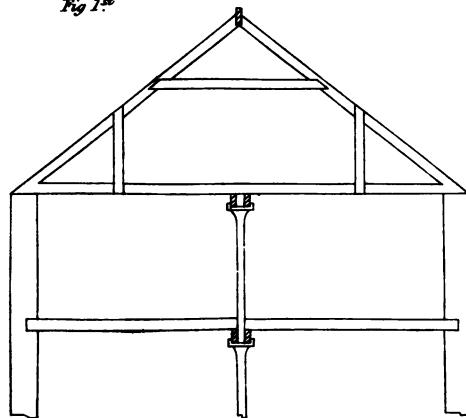
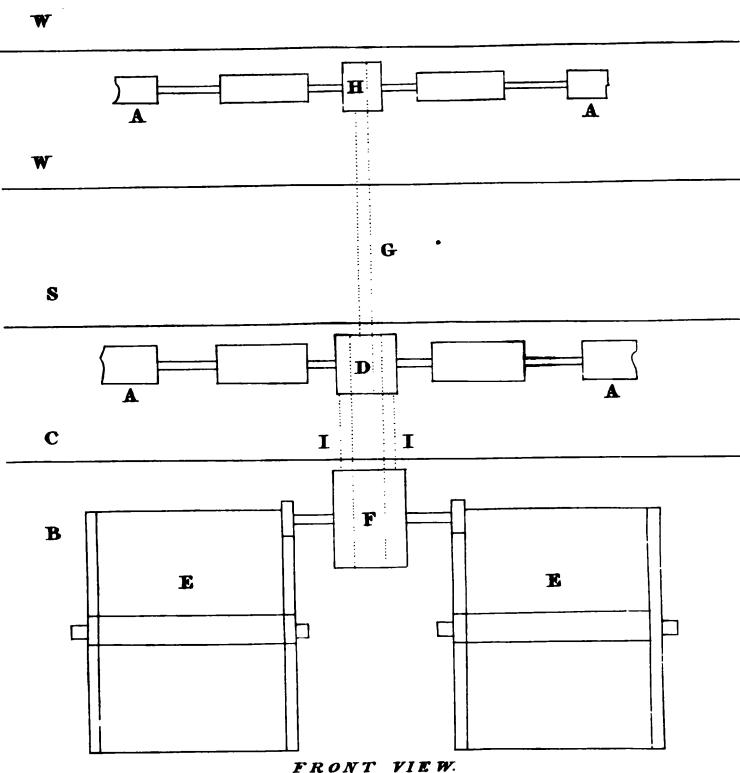


PLATE I.

*Fig 1<sup>st</sup>*



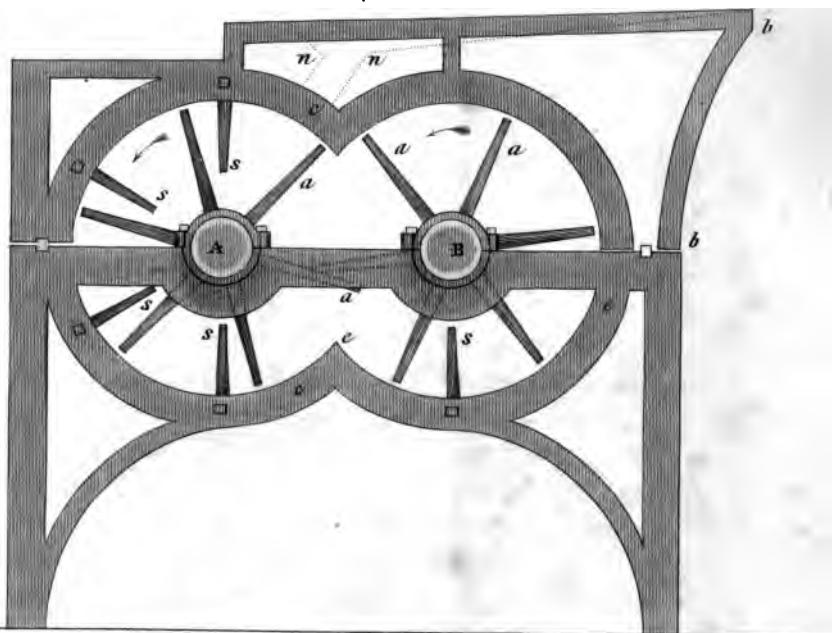
*Fig 3<sup>rd</sup>*



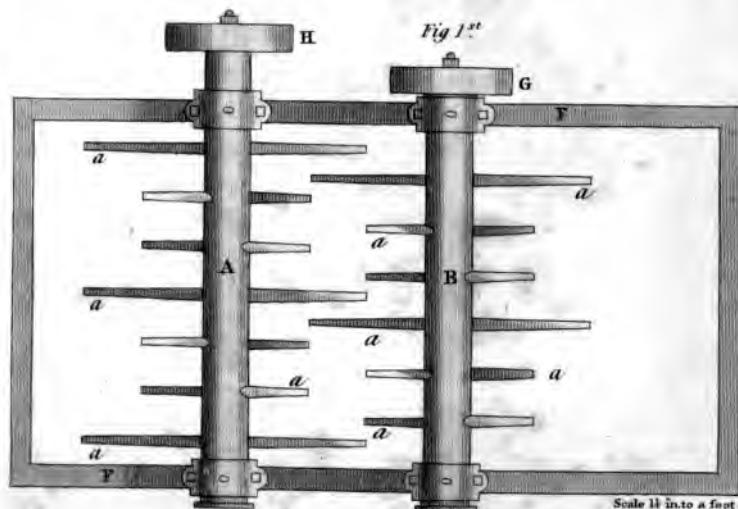


MASON'S WHIPPER.

*Fig 2<sup>d</sup>*



*Fig 1<sup>a</sup>*



Scale 1*b* in. to a foot

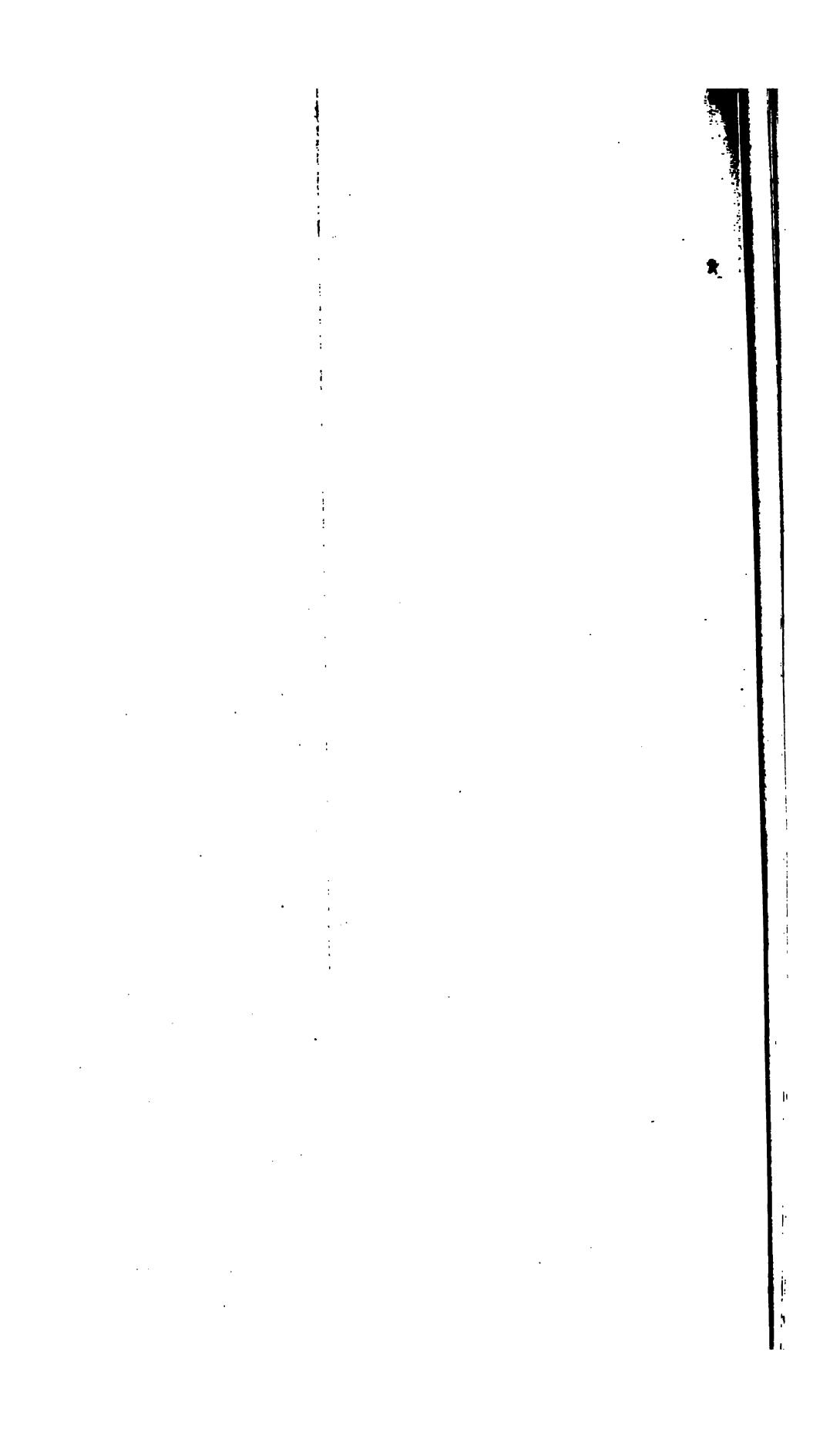
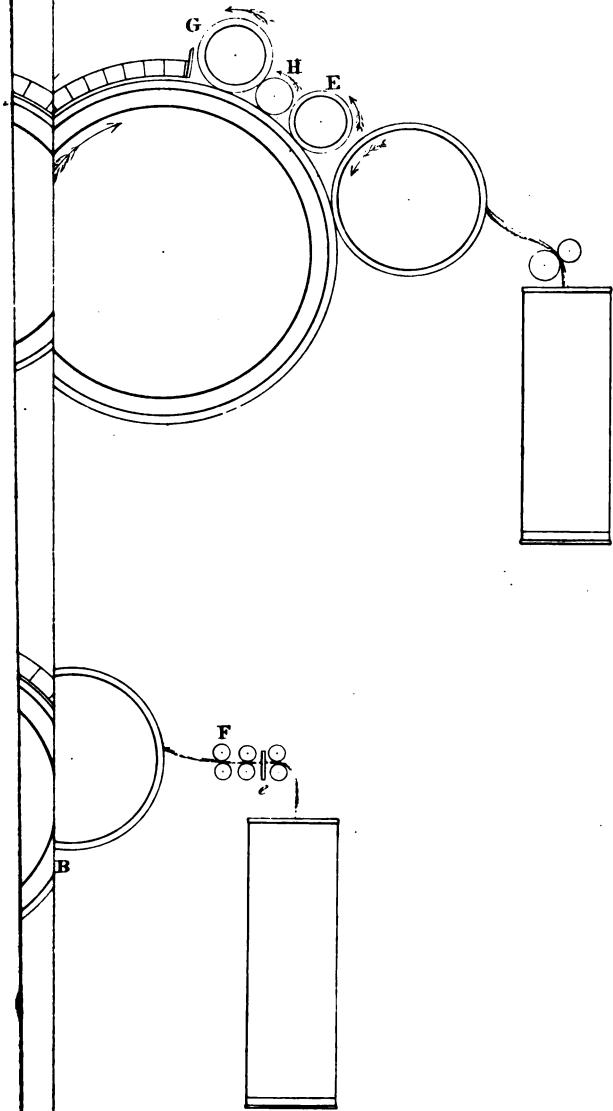


PLATE III.



Scale of one half inch to the foot.

*Swan Sci.*

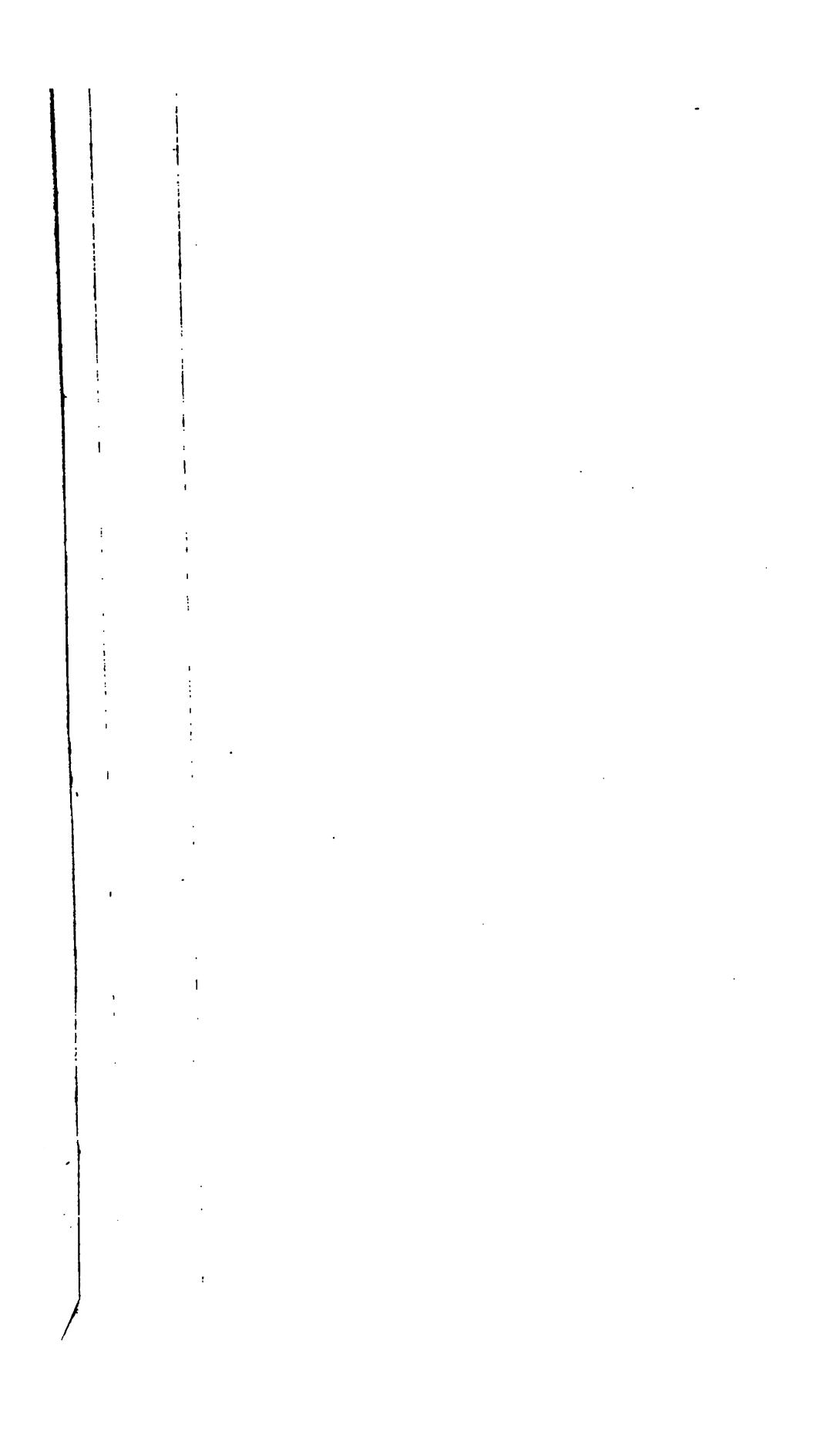
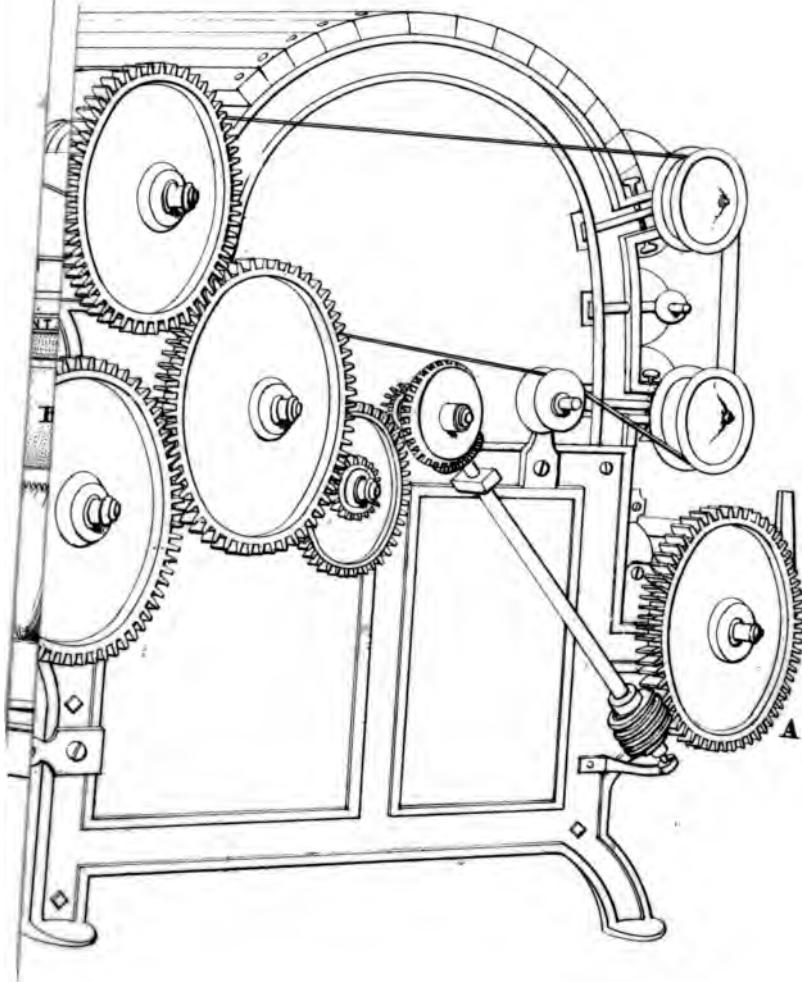
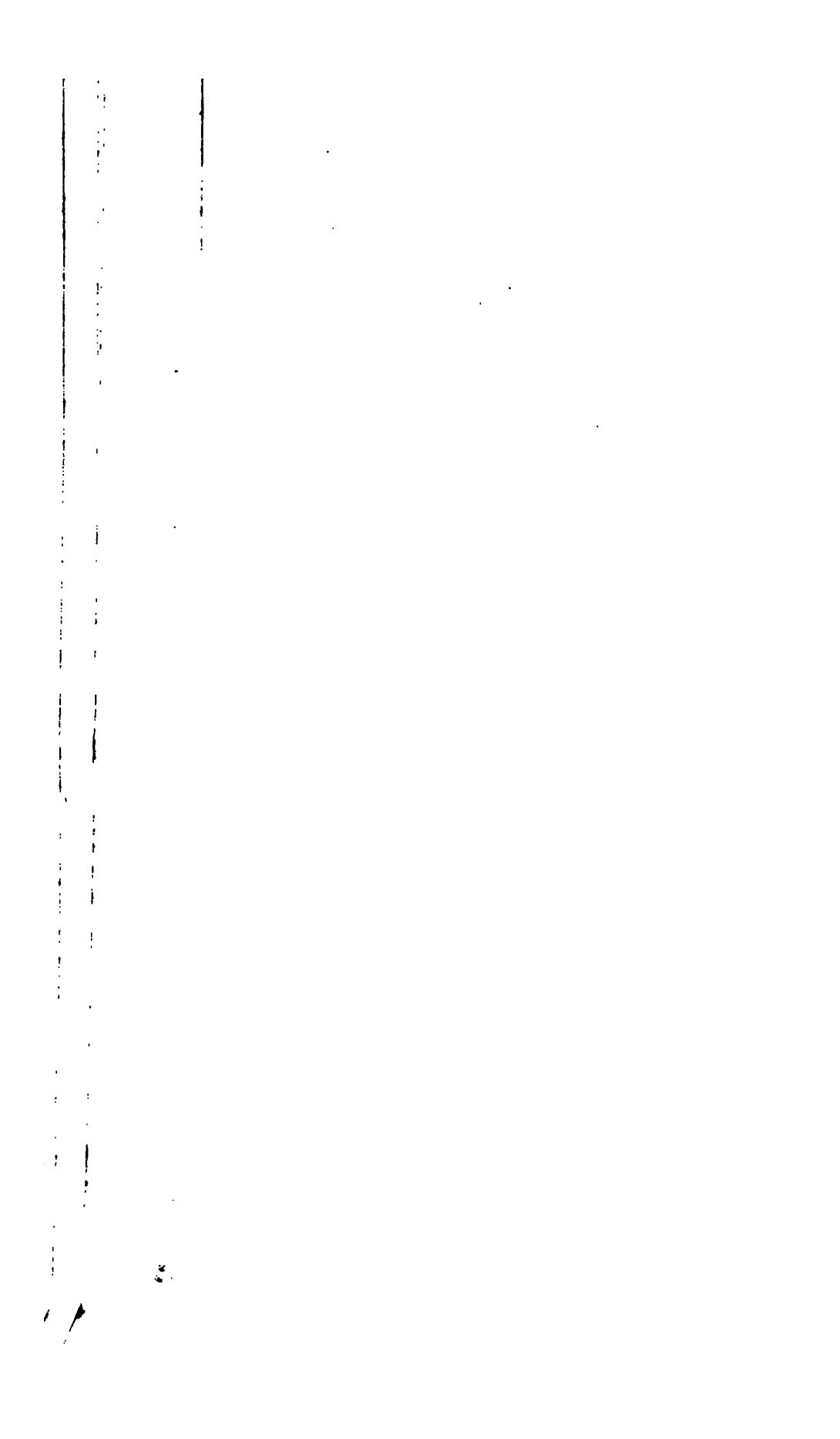


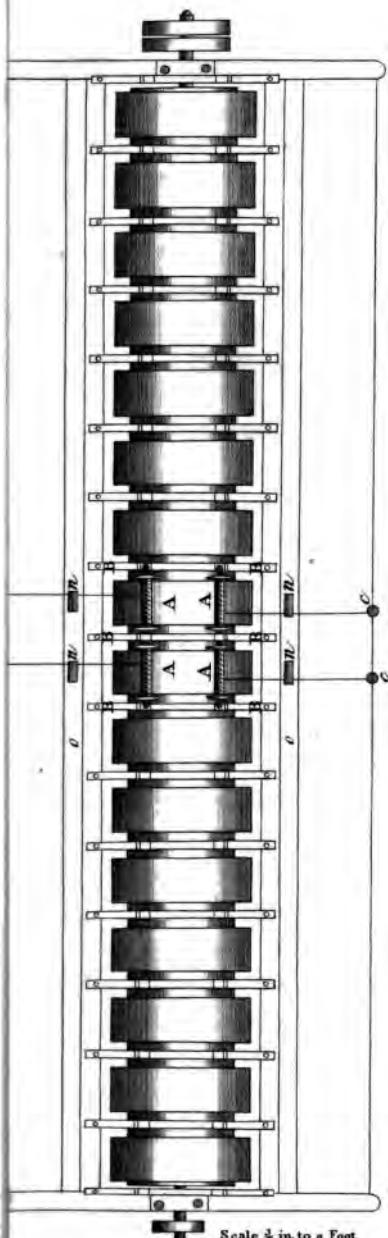
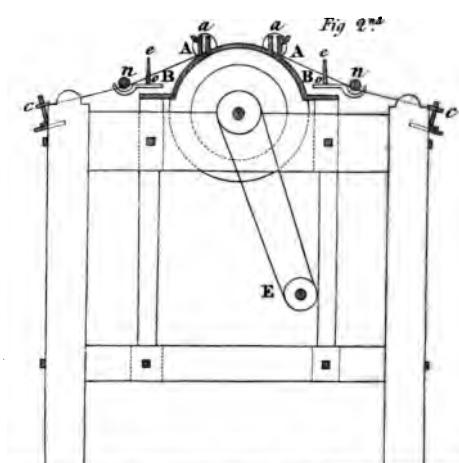
PLATE IV.



MacLure & Macdonald lith<sup>g</sup> Glasgow.



## SPOOLING OR WINDING MACHINE.

Fig 1<sup>st</sup>Scale  $\frac{1}{4}$  in. to a Foot.

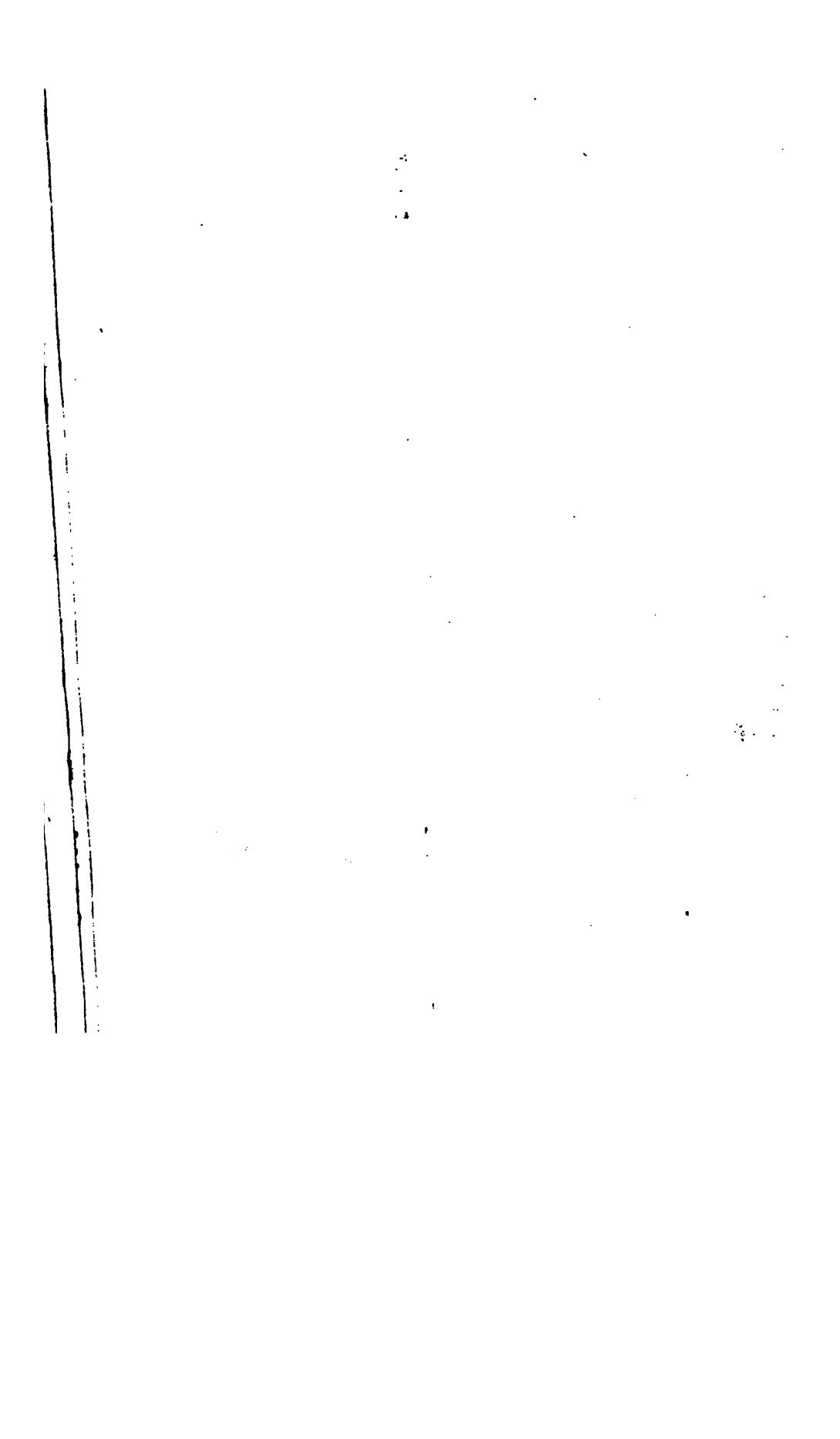
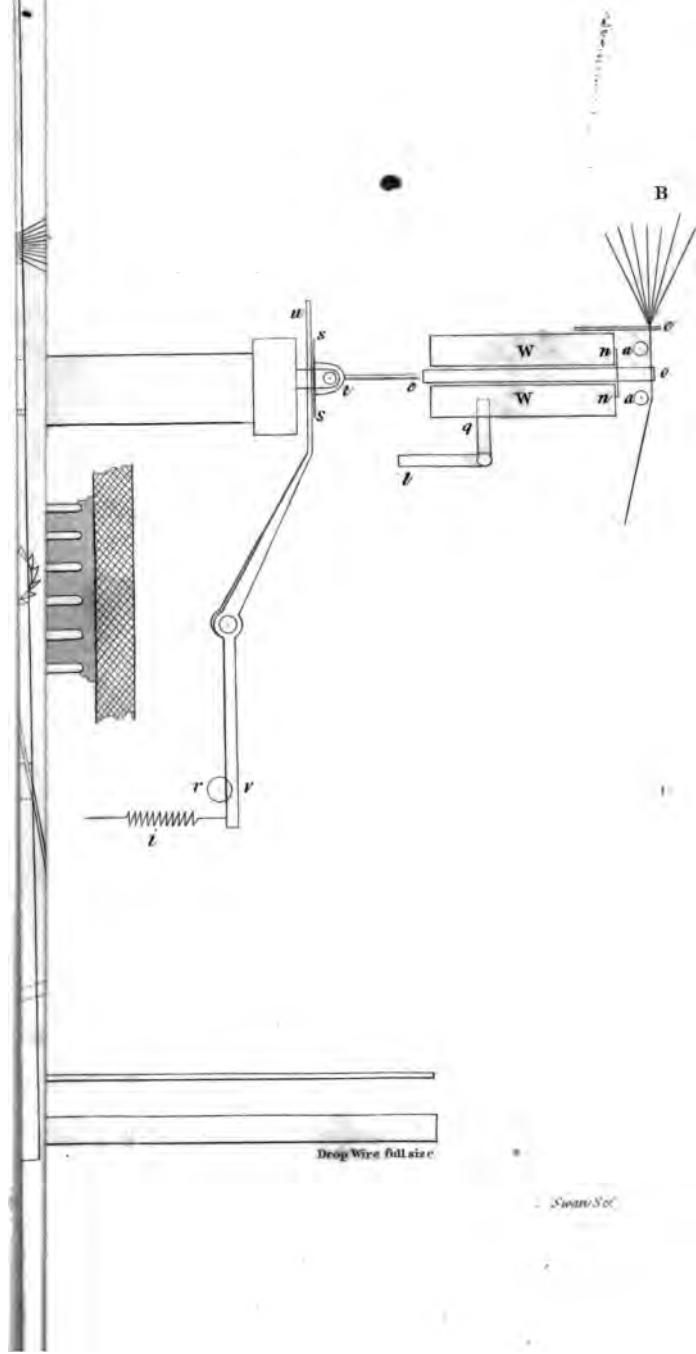


PLATE VI.



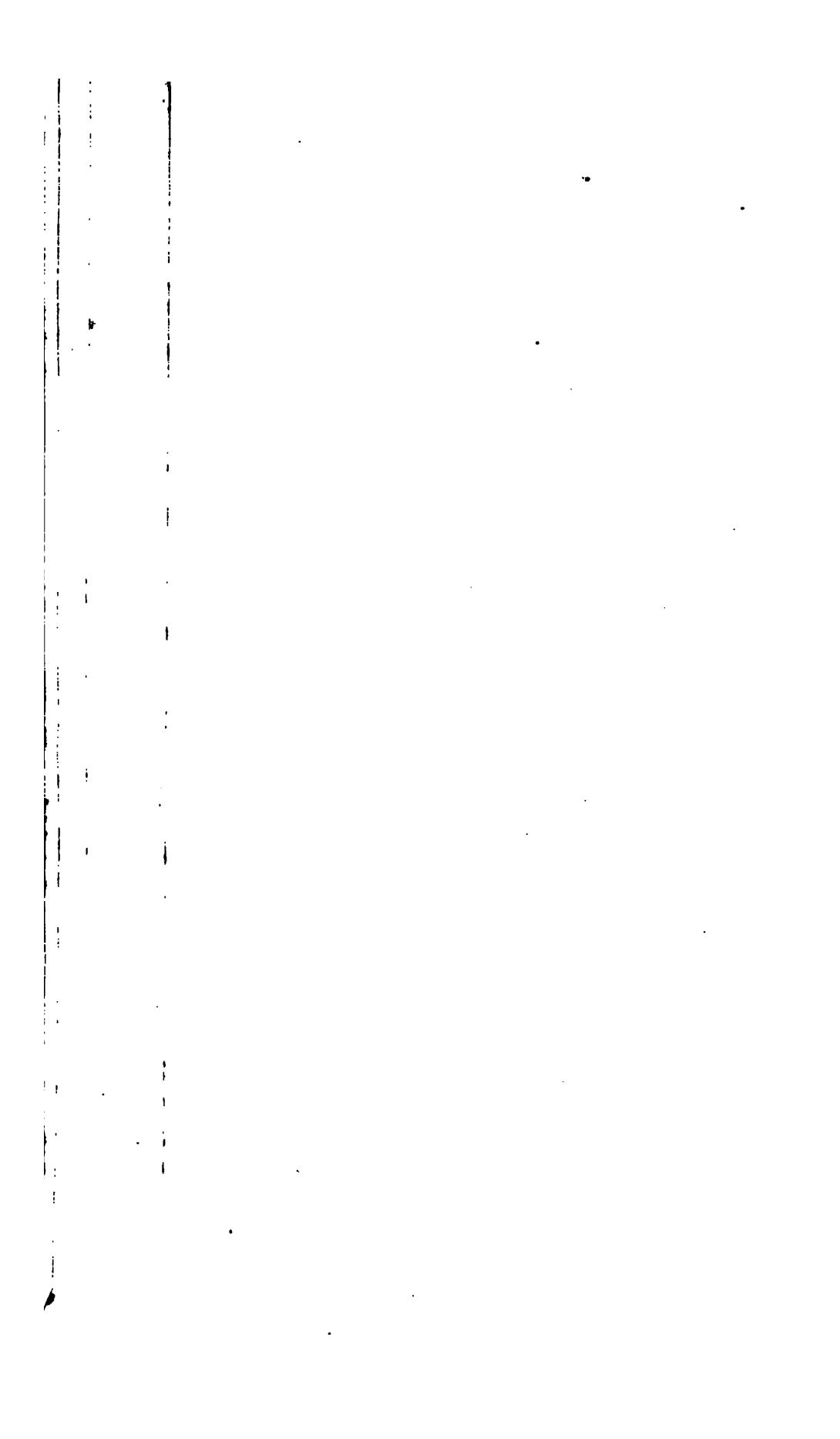
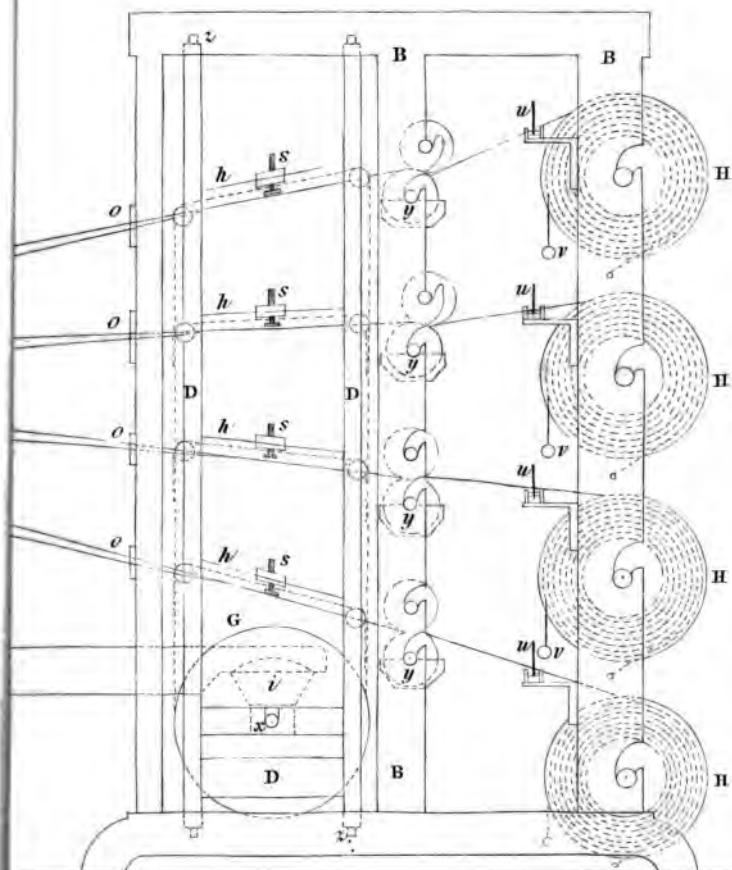
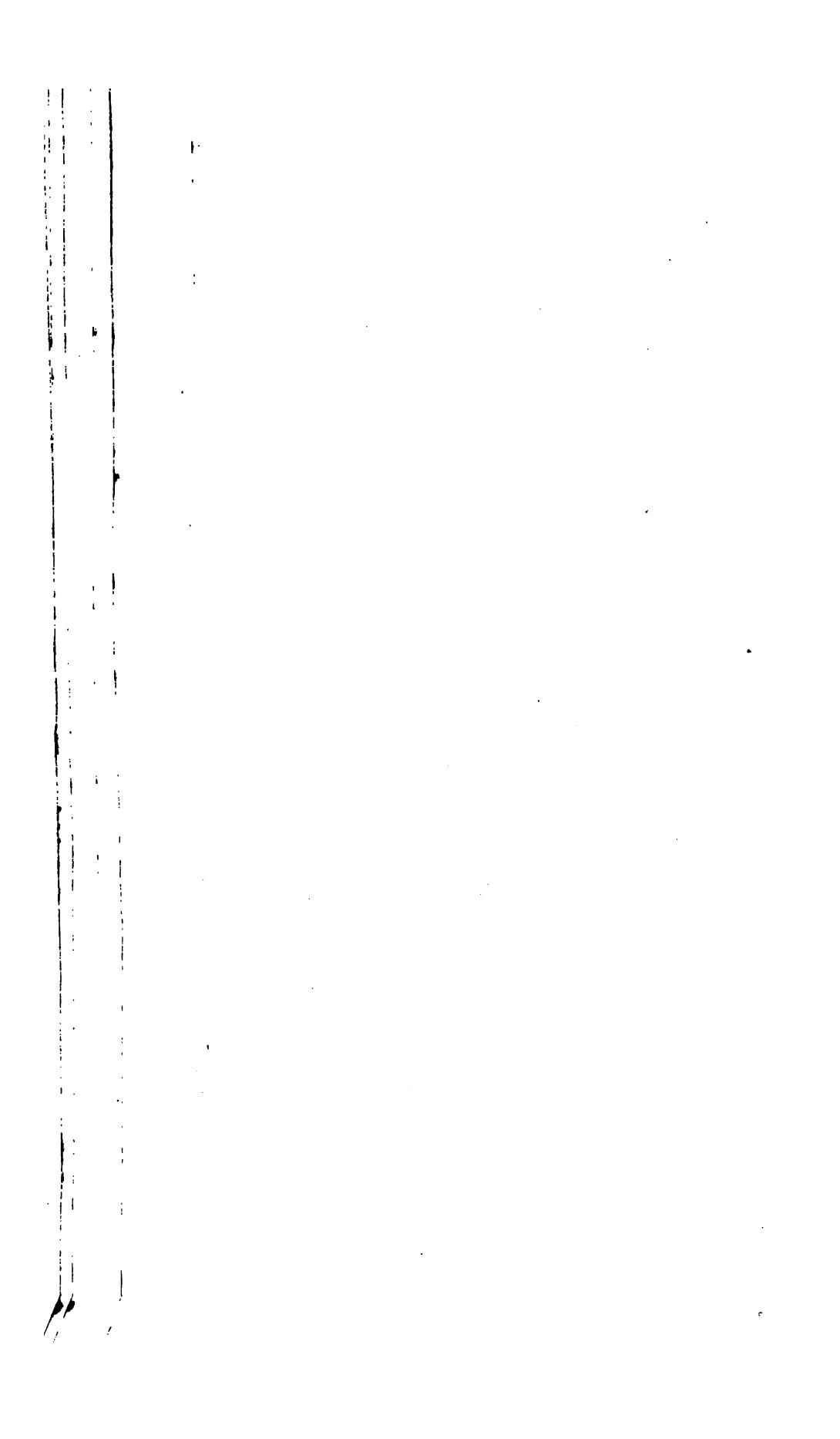


PLATE VII.



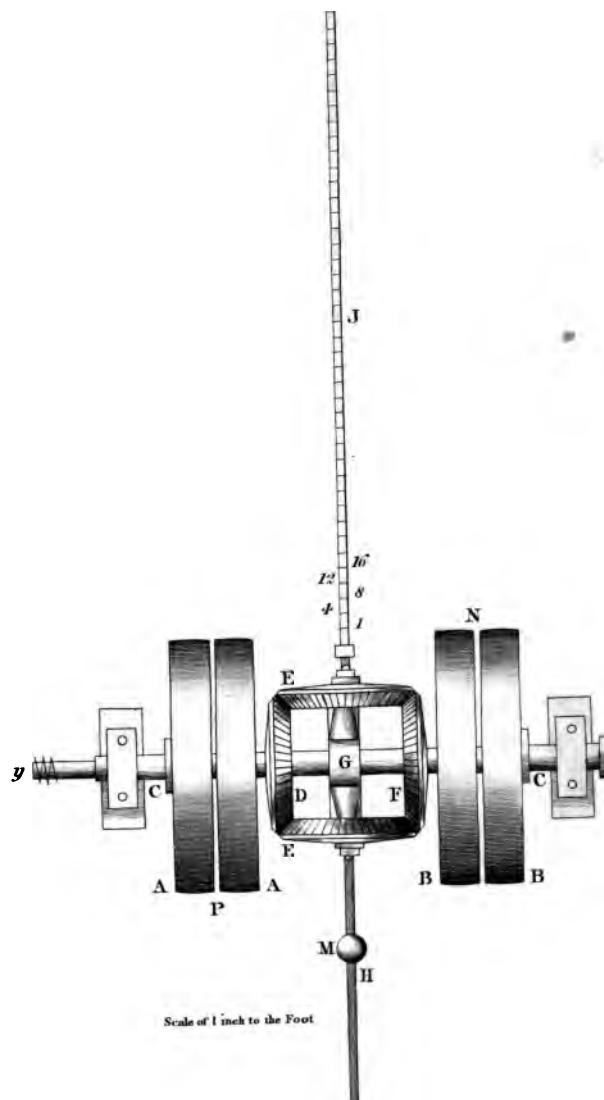
Scale of  $\frac{1}{4}$  inch to the foot.

Second Series



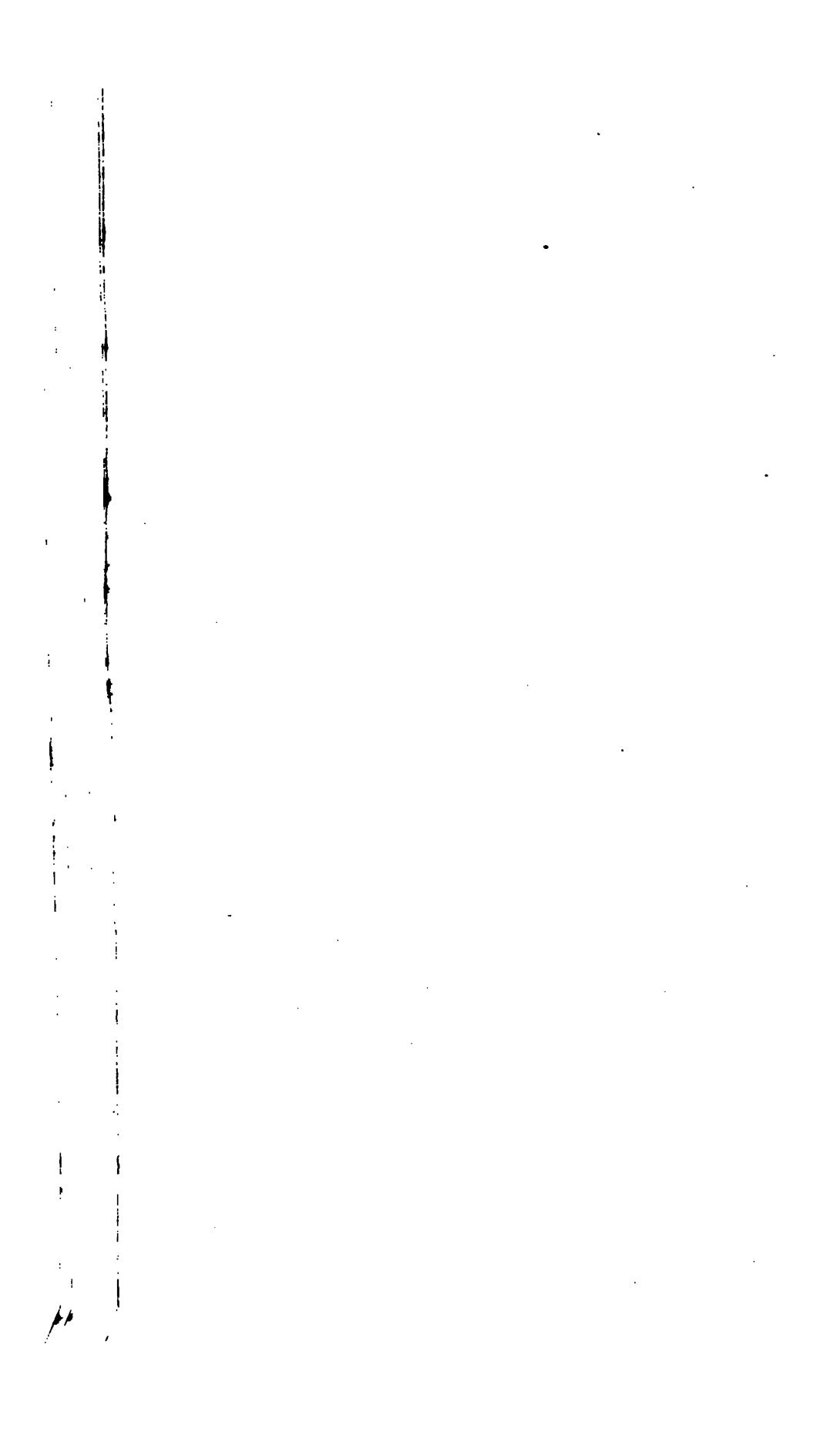
DYNAMOMETER.

Fig 2<sup>nd</sup>



Scale of 1 inch to the Foot

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